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Pike et al.

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(45) **Date of Patent: Nov. 30, 2021**

(54) **USER INTERFACE ENGINE FOR MINIAPP DEVELOPMENT**

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(73) Assignee: **ADP, LLC**, Roseland, NJ (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 89 days.

(21) Appl. No.: **16/585,855**

(22) Filed: **Sep. 27, 2019**

(65) **Prior Publication Data**

US 2021/0096829 A1 Apr. 1, 2021

(51) **Int. Cl.**

G06F 9/44	(2018.01)
G06F 8/34	(2018.01)
G06F 3/0482	(2013.01)
G06Q 10/06	(2012.01)

(52) **U.S. Cl.**

CPC ***G06F 8/34*** (2013.01); ***G06F 3/0482*** (2013.01); ***G06Q 10/0637*** (2013.01)

(58) **Field of Classification Search**

CPC G06F 8/34; G06F 3/0482; G06Q 10/0637

See application file for complete search history.

(56) **References Cited**

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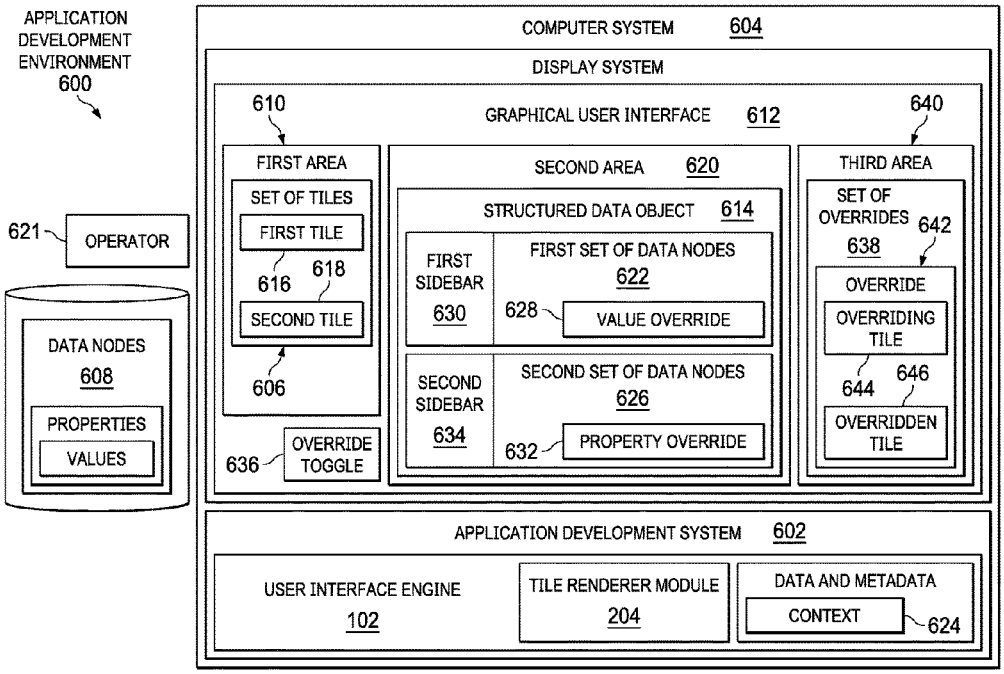
Assistant Examiner — Lenin Paulino
(74) *Attorney, Agent, or Firm* — Yee & Associates. P.C.

(57) **ABSTRACT**

A method, computer system, and computer program product display a set of tiles within a first area of a graphical user interface. Each tile corresponds to a set of data nodes that are composable structured data objects according to a domain-specific language. A structured data object is composed from selected tiles and is displayed within a second area of the graphical user interface. Displaying the structured data object includes displaying a first tile and a second tile within a context of the structured data object. A value override is displayed at the first tile when a first value of the first set of data nodes is overridden by a second value of the second set of data nodes.

12 Claims, 21 Drawing Sheets



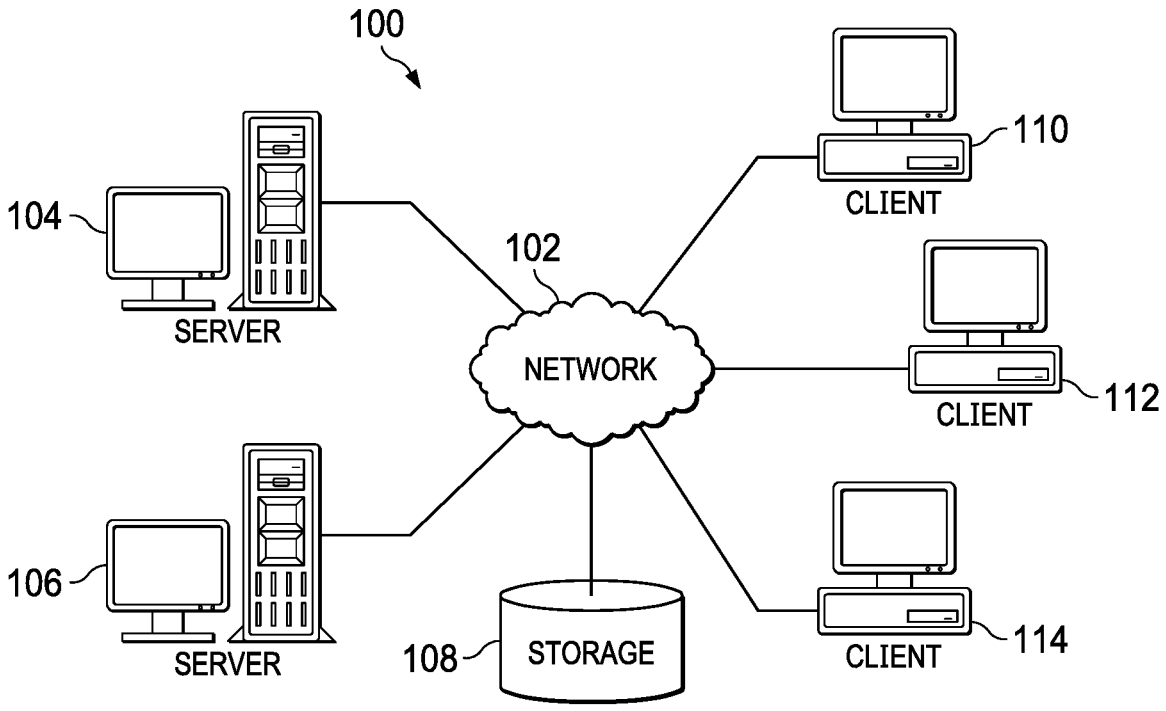

100
104
SERVER
102
NETWORK
110
CLIENT
112
CLIENT
106
SERVER
108
STORAGE
114
CLIENT

FIG. 1

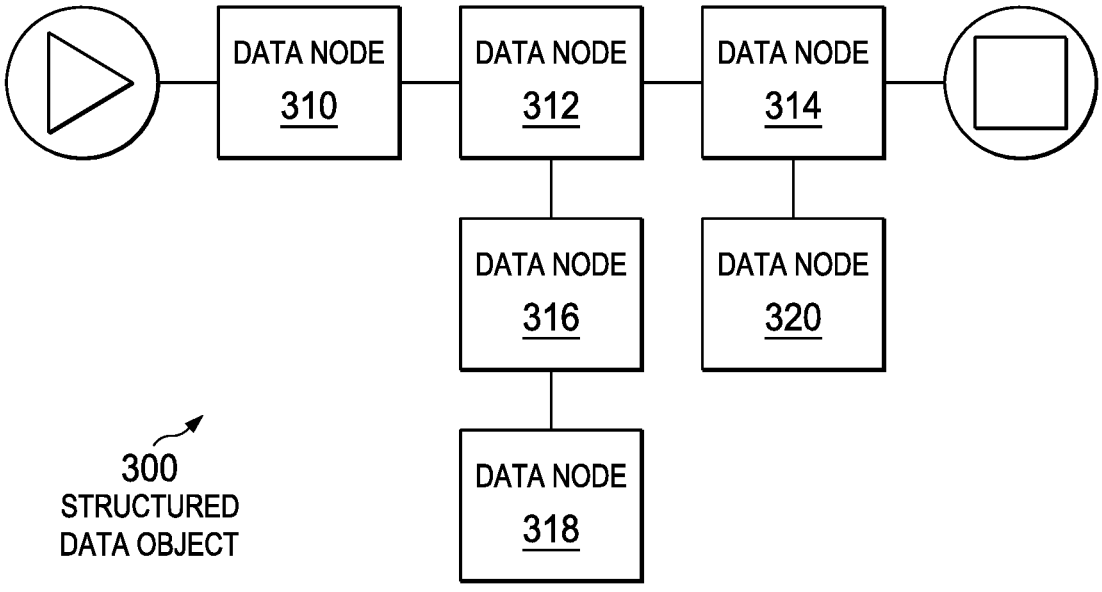

DATA NODE
310
DATA NODE
312
DATA NODE
314
DATA NODE
316
DATA NODE
320
DATA NODE
318
300
STRUCTURED
DATA OBJECT

FIG. 3

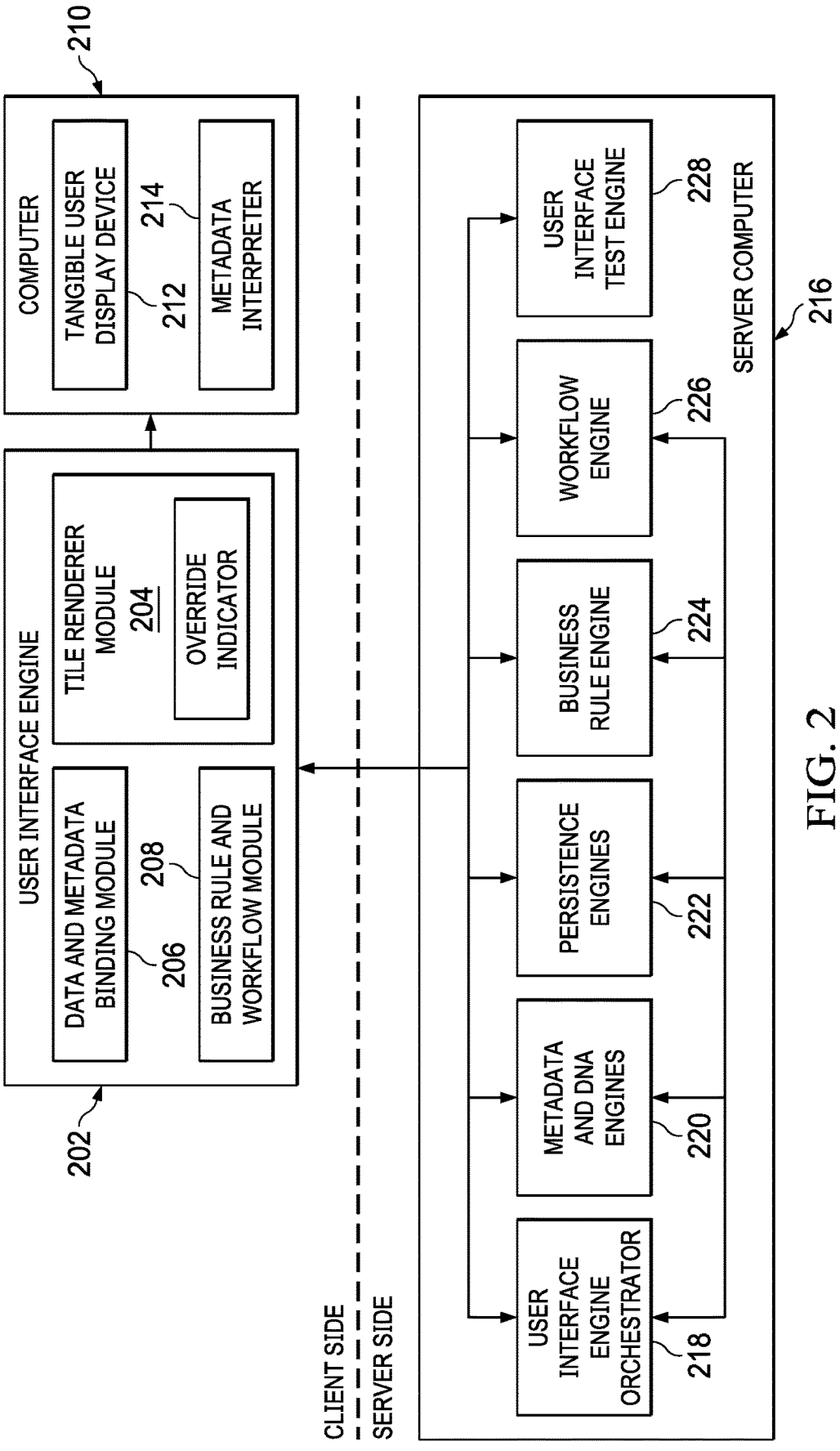

210
COMPUTER
TANGIBLE USER DISPLAY DEVICE
212
214
METADATA INTERPRETER
USER INTERFACE ENGINE
TILE RENDERER MODULE
204
OVERRIDE INDICATOR
DATA AND METADATA BINDING MODULE
206
208
BUSINESS RULE AND WORKFLOW MODULE
202
CLIENT SIDE
SERVER SIDE
USER INTERFACE TEST ENGINE
228
WORKFLOW ENGINE
226
BUSINESS RULE ENGINE
224
PERSISTENCE ENGINES
222
METADATA AND DNA ENGINES
220
USER INTERFACE ENGINE ORCHESTRATOR
218
SERVER COMPUTER
216

FIG. 2

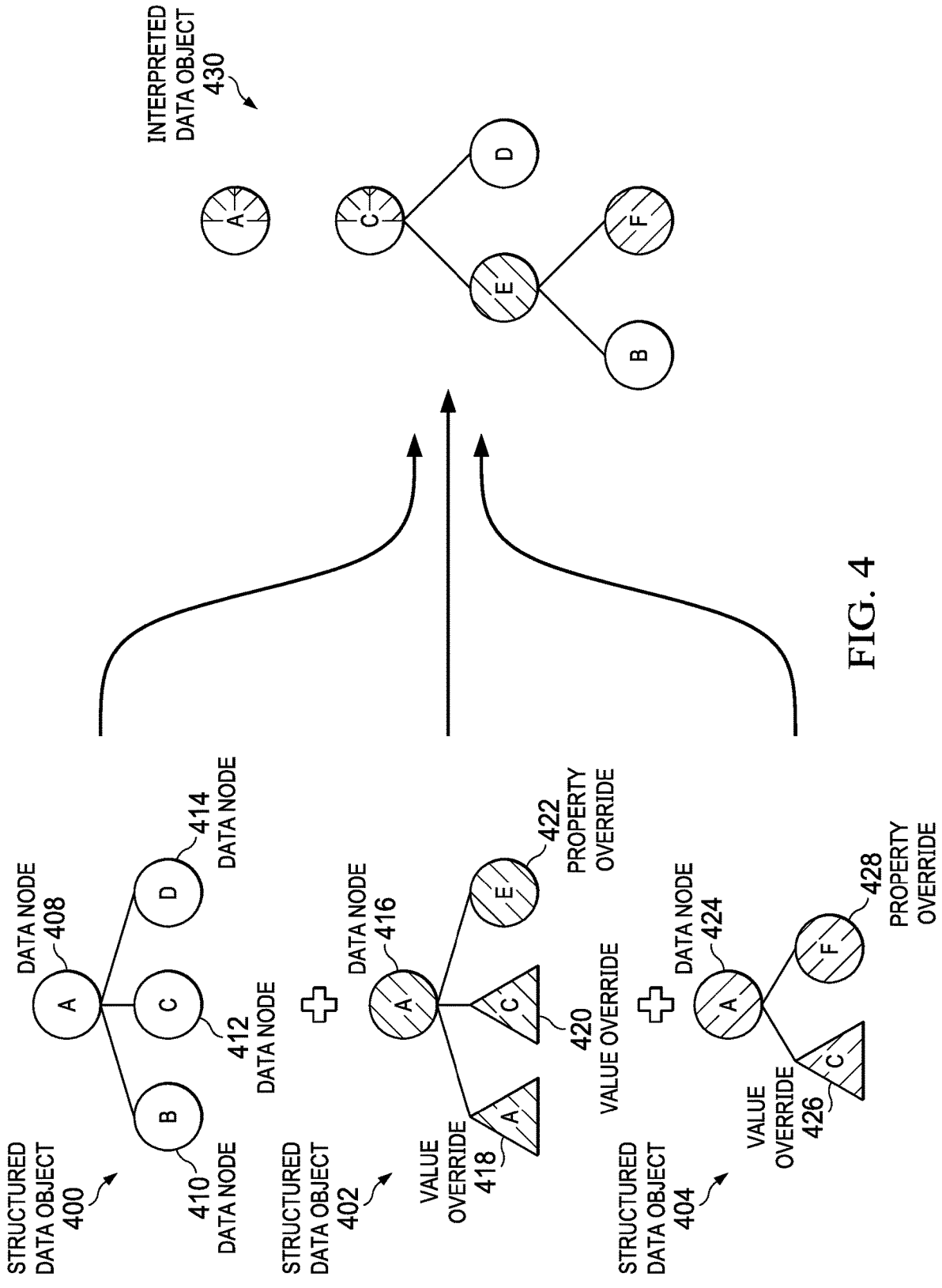

INTERPRETED DATA OBJECT 430
A
C
D
E
F
B
STRUCTURED DATA OBJECT 400
DATA NODE 408
A
B
C
D
410 DATA NODE
412 DATA NODE
414 DATA NODE
STRUCTURED DATA OBJECT 402
DATA NODE 416
A
C
E
VALUE OVERRIDE 418
A
420 VALUE OVERRIDE
422 PROPERTY OVERRIDE
STRUCTURED DATA OBJECT 404
DATA NODE 424
A
F
VALUE OVERRIDE 426
C
428 PROPERTY OVERRIDE

FIG. 4

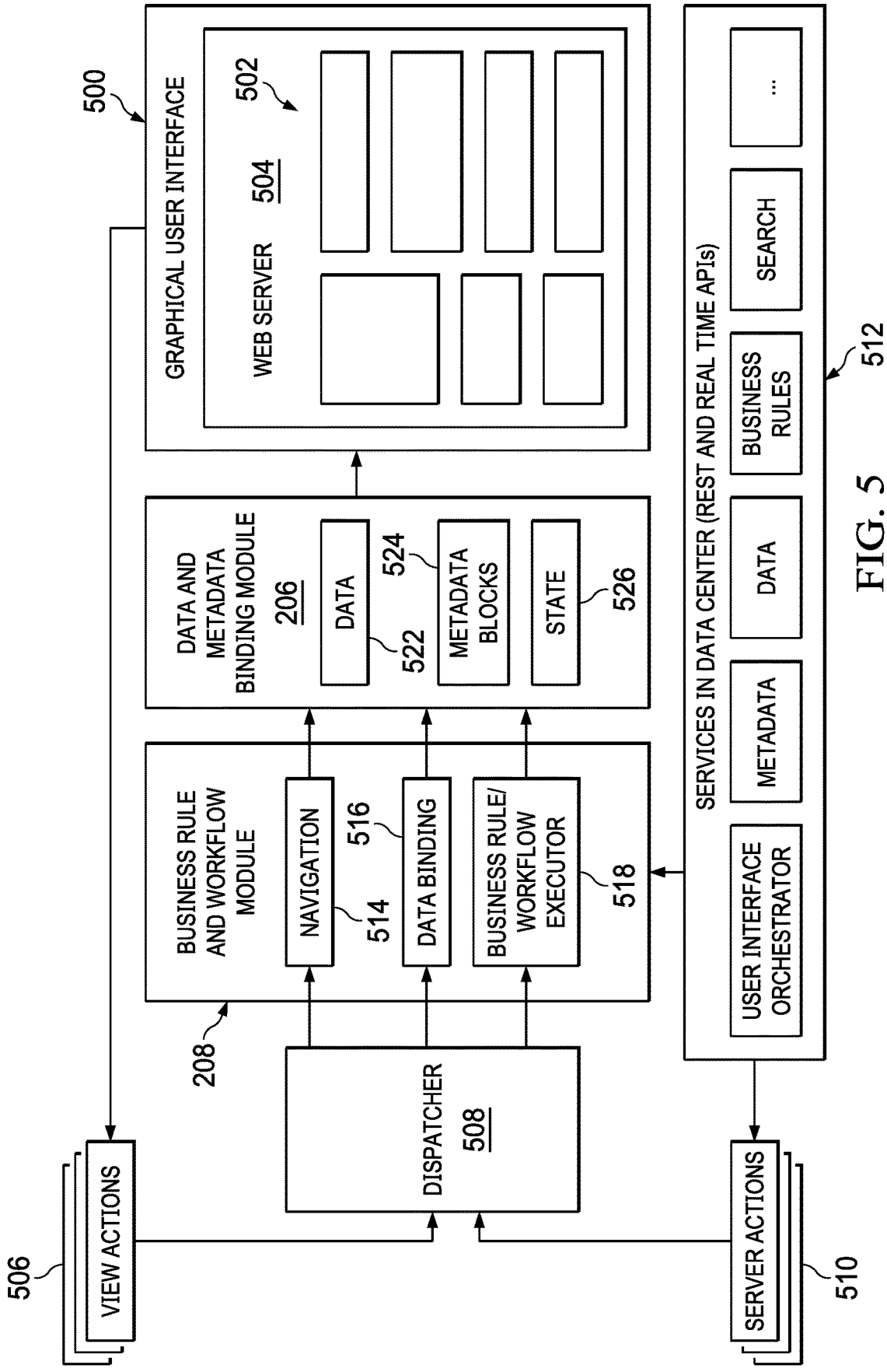

500
GRAPHICAL USER INTERFACE
502
WEB SERVER
504
DATA AND METADATA BINDING MODULE
206
DATA
522
524
METADATA BLOCKS
STATE
526
BUSINESS RULE AND WORKFLOW MODULE
NAVIGATION
514
516
DATA BINDING
BUSINESS RULE/ WORKFLOW EXECUTOR
518
208
DISPATCHER
508
SERVICES IN DATA CENTER (REST AND REAL TIME APIs)
USER INTERFACE ORCHESTRATOR
METADATA
DATA
BUSINESS RULES
SEARCH
...
512
VIEW ACTIONS
506
SERVER ACTIONS
510

FIG. 5

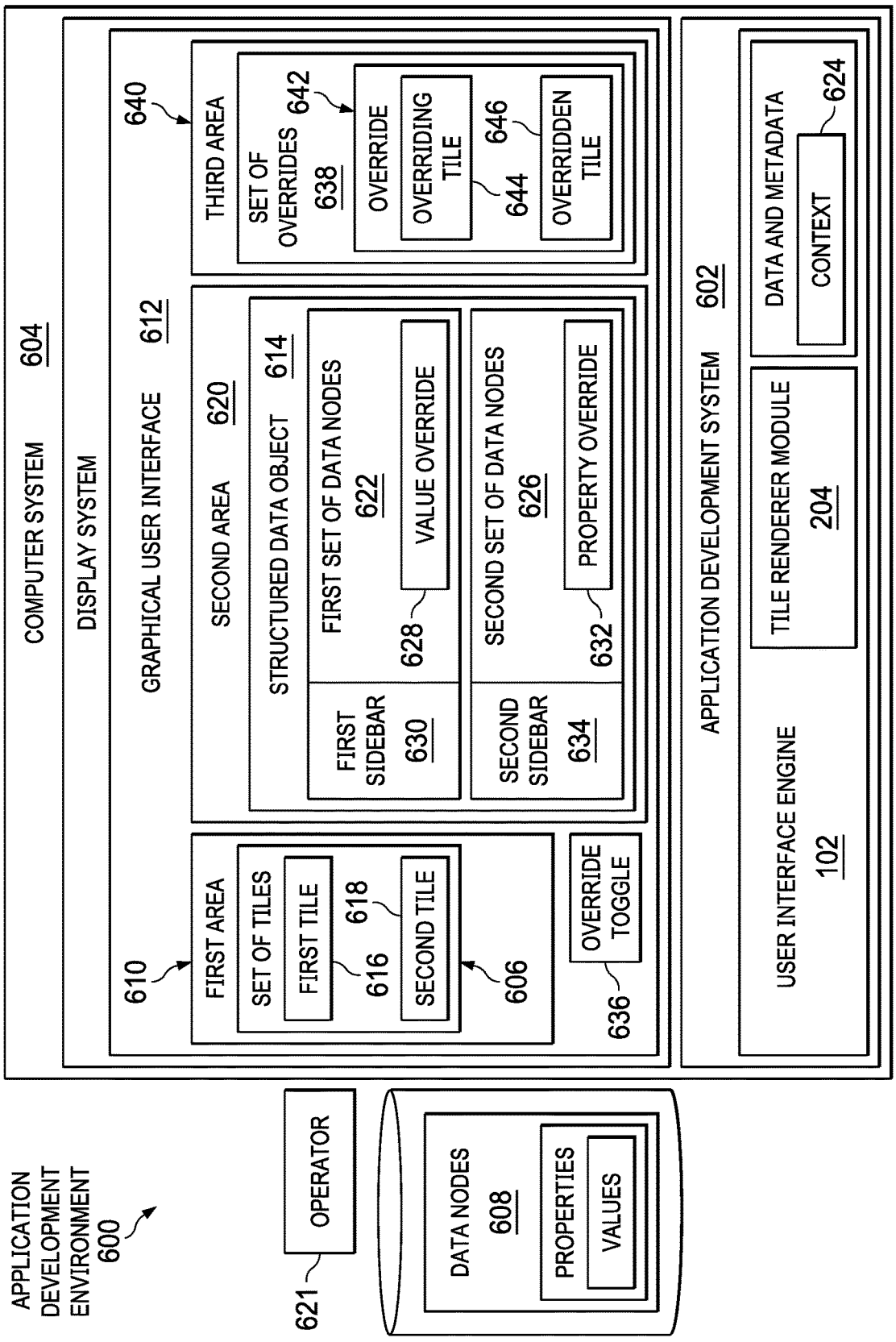

APPLICATION DEVELOPMENT ENVIRONMENT 600
COMPUTER SYSTEM 604
DISPLAY SYSTEM
GRAPHICAL USER INTERFACE 612
610
FIRST AREA
SET OF TILES
FIRST TILE
616
618
SECOND TILE
606
OVERRIDE TOGGLE
636
SECOND AREA 620
STRUCTURED DATA OBJECT 614
FIRST SET OF DATA NODES 622
FIRST SIDEBAR 630
628
VALUE OVERRIDE
SECOND SET OF DATA NODES 626
SECOND SIDEBAR 634
632
PROPERTY OVERRIDE
640
THIRD AREA
SET OF OVERRIDES 642
638
OVERRIDE
OVERRIDING TILE
644
646
OVERRIDDEN TILE
APPLICATION DEVELOPMENT SYSTEM 602
USER INTERFACE ENGINE 102
TILE RENDERER MODULE 204
DATA AND METADATA
CONTEXT
624
621
OPERATOR
DATA NODES 608
PROPERTIES
VALUES

FIG. 6

FIG. 7A

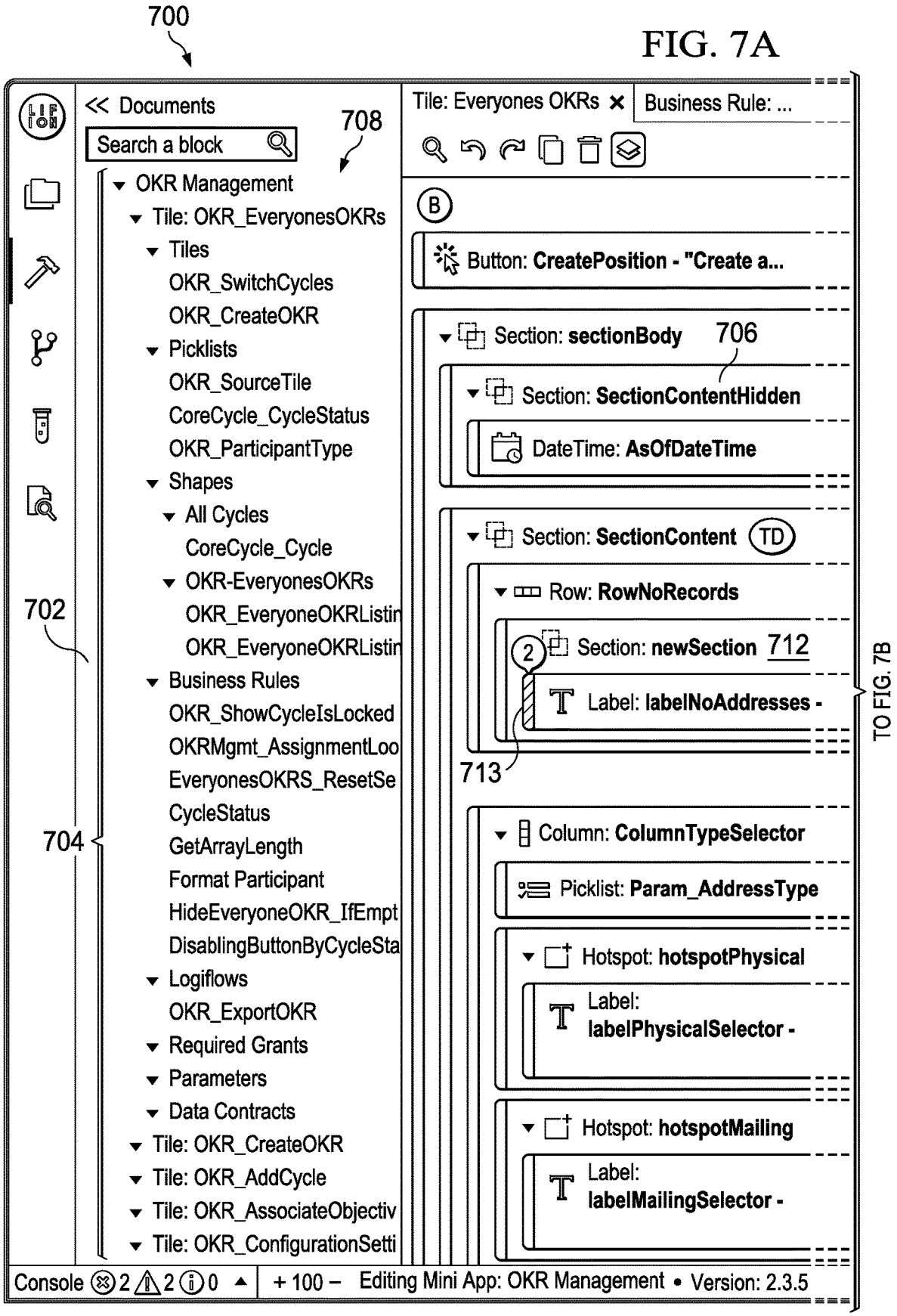

700
<< Documents
Search a block
708
OKR Management
Tile: OKR_EveryonesOKRs
Tiles
OKR_SwitchCycles
OKR_CreateOKR
Picklists
OKR_SourceTile
CoreCycle_CycleStatus
OKR_ParticipantType
Shapes
All Cycles
CoreCycle_Cycle
OKR-EveryonesOKRs
OKR_EveryoneOKRListin
OKR_EveryoneOKRListin
Business Rules
OKR_ShowCycleIsLocked
OKRMgmt_AssignmentLoo
EveryonesOKRS_ResetSe
CycleStatus
GetArrayLength
Format Participant
HideEveryoneOKR_IfEmpt
DisablingButtonByCycleSta
Logiflows
OKR_ExportOKR
Required Grants
Parameters
Data Contracts
Tile: OKR_CreateOKR
Tile: OKR_AddCycle
Tile: OKR_AssociateObjectiv
Tile: OKR_ConfigurationSetti
702
704
Tile: Everyones OKRs
Business Rule: ...
B
Button: CreatePosition - "Create a...
Section: sectionBody
706
Section: SectionContentHidden
DateTime: AsOfDateTime
Section: SectionContent
TD
Row: RowNoRecords
2
Section: newSection
712
Label: labelNoAddresses -
713
Column: ColumnTypeSelector
Picklist: Param_AddressType
Hotspot: hotspotPhysical
Label: labelPhysicalSelector -
Hotspot: hotspotMailing
Label: labelMailingSelector -
TO FIG. 7B
Console 2 2 0
+ 100 –
Editing Mini App: OKR Management • Version: 2.3.5

FIG. 7B

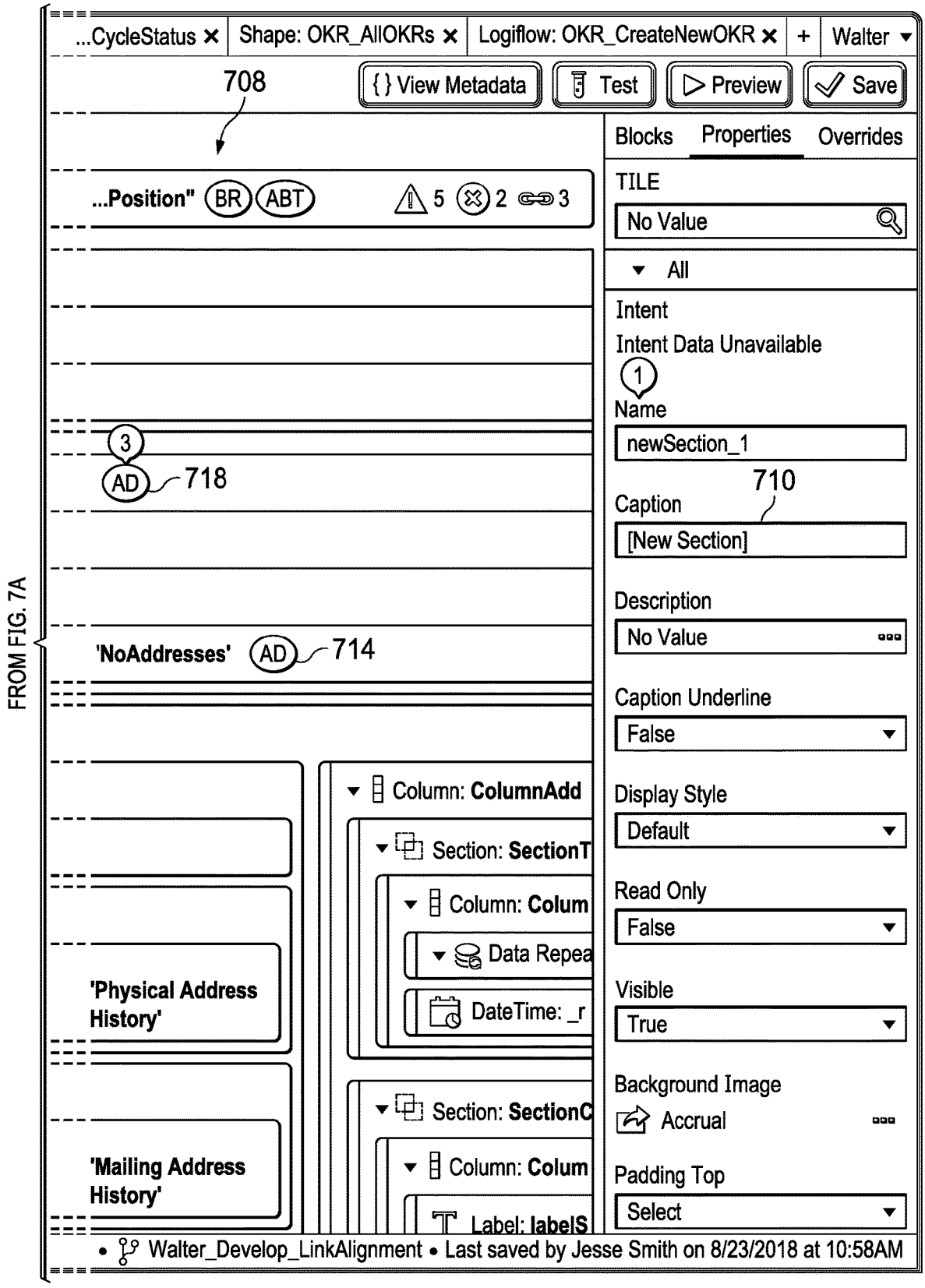

...CycleStatus
Shape: OKR_AllOKRs
Logiflow: OKR_CreateNewOKR
Walter
708
{} View Metadata
Test
Preview
Save
Blocks
Properties
Overrides
...Position" BR ABT
5 2 3
TILE
No Value
All
Intent
Intent Data Unavailable
1
Name
newSection_1
3
AD
718
710
Caption
[New Section]
Description
No Value
'NoAddresses' AD
714
Caption Underline
False
Column: ColumnAdd
Display Style
Default
Section: SectionT
Column: Colum
Read Only
False
Data Repea
'Physical Address History'
DateTime: _r
Visible
True
Background Image
Section: SectionC
Accrual
Column: Colum
'Mailing Address History'
Padding Top
Label: labelS
Select
FROM FIG. 7A
Walter_Develop_LinkAlignment • Last saved by Jesse Smith on 8/23/2018 at 10:58AM

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FIG. 8A

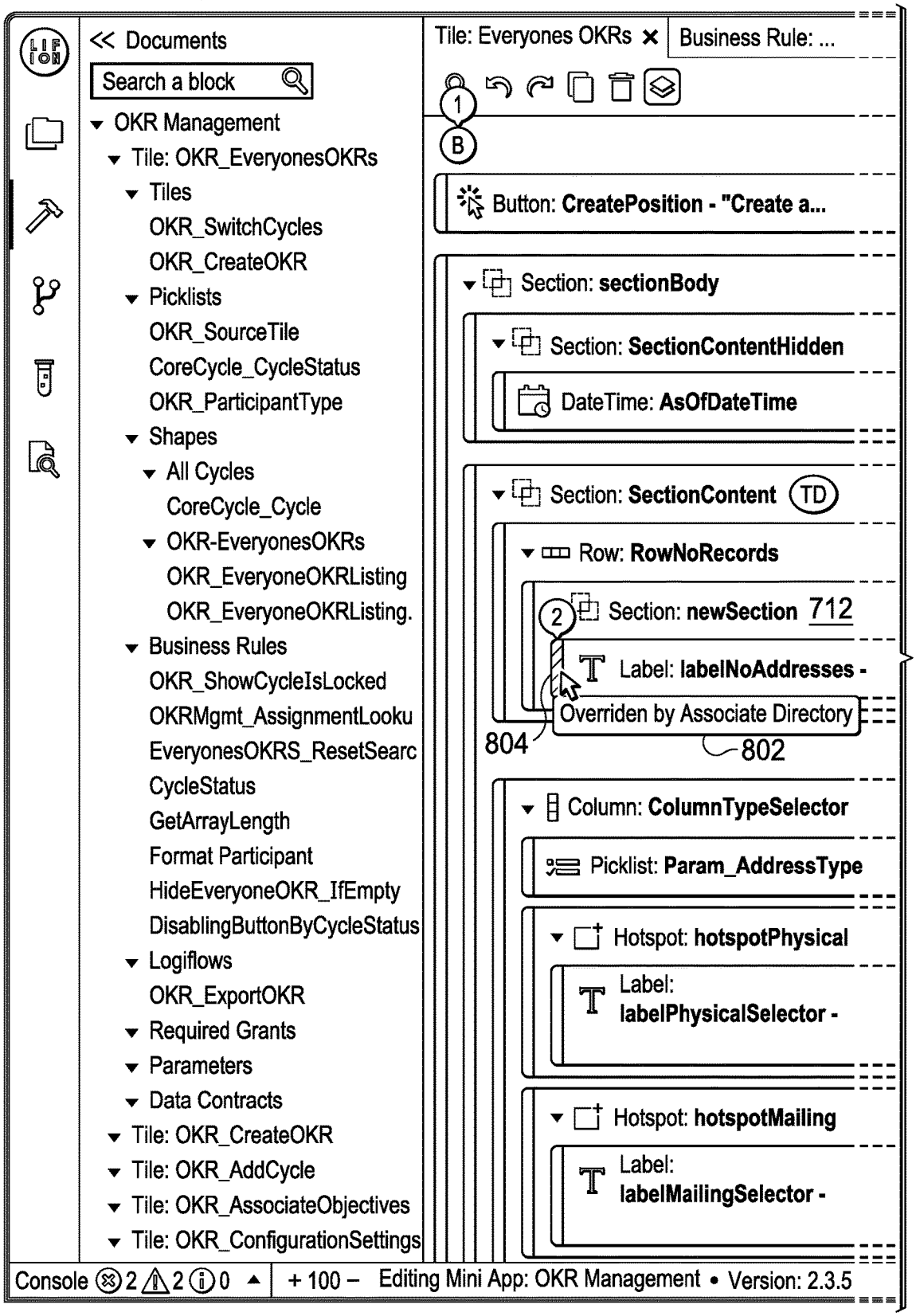
Documents
Search a block
OKR Management
Tile: OKR_EveryonesOKRs
Tiles
OKR_SwitchCycles
OKR_CreateOKR
Picklists
OKR_SourceTile
CoreCycle_CycleStatus
OKR_ParticipantType
Shapes
All Cycles
CoreCycle_Cycle
OKR-EveryonesOKRs
OKR_EveryoneOKRListing
OKR_EveryoneOKRListing.
Business Rules
OKR_ShowCycleIsLocked
OKRMgmt_AssignmentLooku
EveryonesOKRS_ResetSearc
CycleStatus
GetArrayLength
Format Participant
HideEveryoneOKR_IfEmpty
DisablingButtonByCycleStatus
Logiflows
OKR_ExportOKR
Required Grants
Parameters
Data Contracts
Tile: OKR_CreateOKR
Tile: OKR_AddCycle
Tile: OKR_AssociateObjectives
Tile: OKR_ConfigurationSettings
Tile: Everyones OKRs
Business Rule: ...
1
B
Button: CreatePosition - "Create a...
Section: sectionBody
Section: SectionContentHidden
DateTime: AsOfDateTime
Section: SectionContent
TD
Row: RowNoRecords
2
Section: newSection 712
Label: labelNoAddresses -
Overriden by Associate Directory
804
802
Column: ColumnTypeSelector
Picklist: Param_AddressType
Hotspot: hotspotPhysical
Label:
labelPhysicalSelector -
Hotspot: hotspotMailing
Label:
labelMailingSelector -
TO FIG. 8B
Console 2 2 0
+ 100 –
Editing Mini App: OKR Management • Version: 2.3.5

FIG. 8B

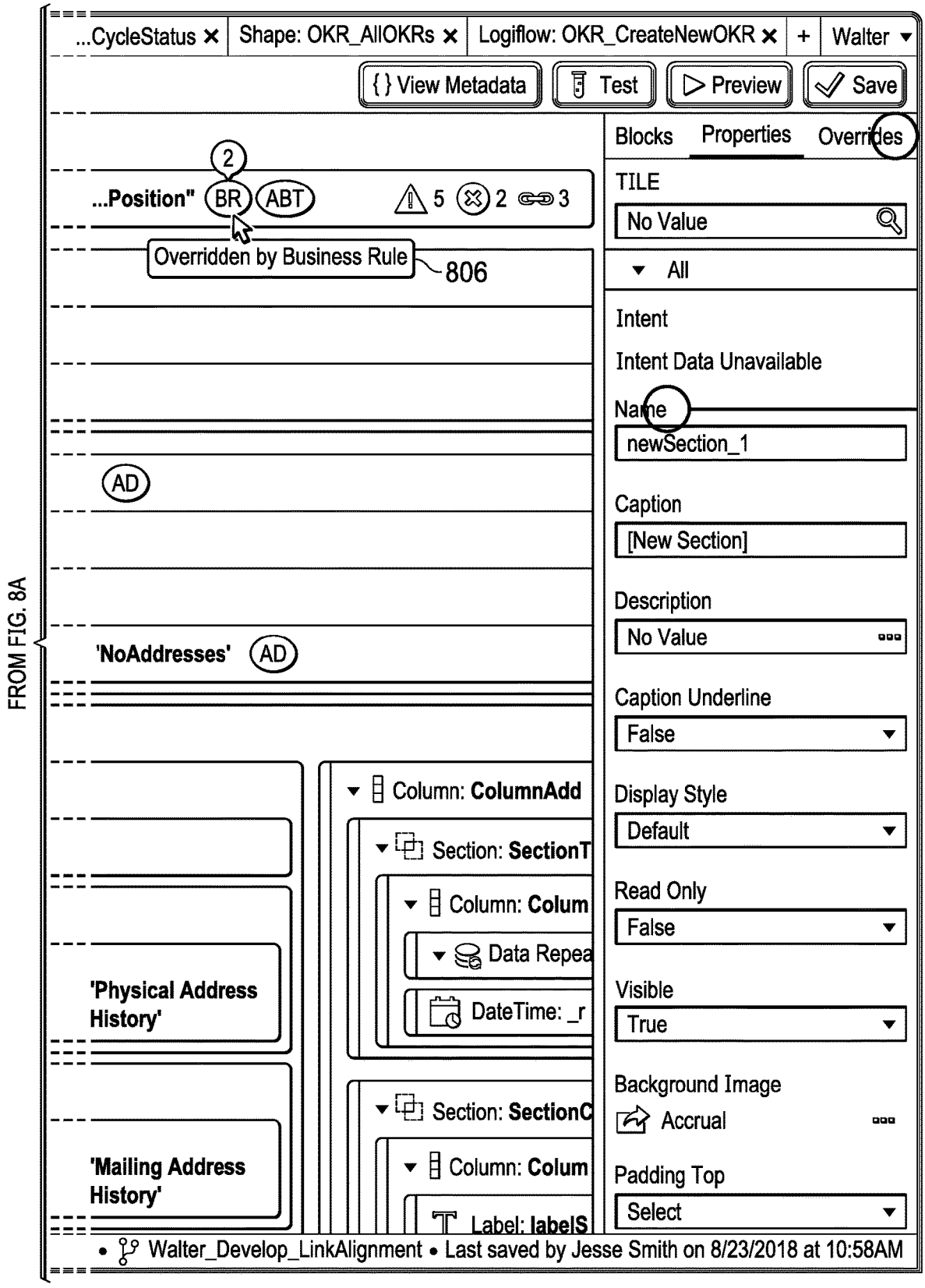
...CycleStatus
Shape: OKR_AllOKRs
Logiflow: OKR_CreateNewOKR
Walter
{} View Metadata
Test
Preview
Save
Blocks
Properties
Overrides
2
...Position"
BR
ABT
5
2
3
Overridden by Business Rule
806
TILE
No Value
All
Intent
Intent Data Unavailable
Name
newSection_1
AD
Caption
[New Section]
Description
No Value
'NoAddresses'
AD
Caption Underline
False
Column: ColumnAdd
Section: SectionT
Column: Colum
Data Repea
DateTime: _r
Display Style
Default
Read Only
False
'Physical Address History'
Visible
True
Section: SectionC
Column: Colum
Label: labelS
Background Image
Accrual
'Mailing Address History'
Padding Top
Select
FROM FIG. 8A
Walter_Develop_LinkAlignment • Last saved by Jesse Smith on 8/23/2018 at 10:58AM

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FIG. 9A

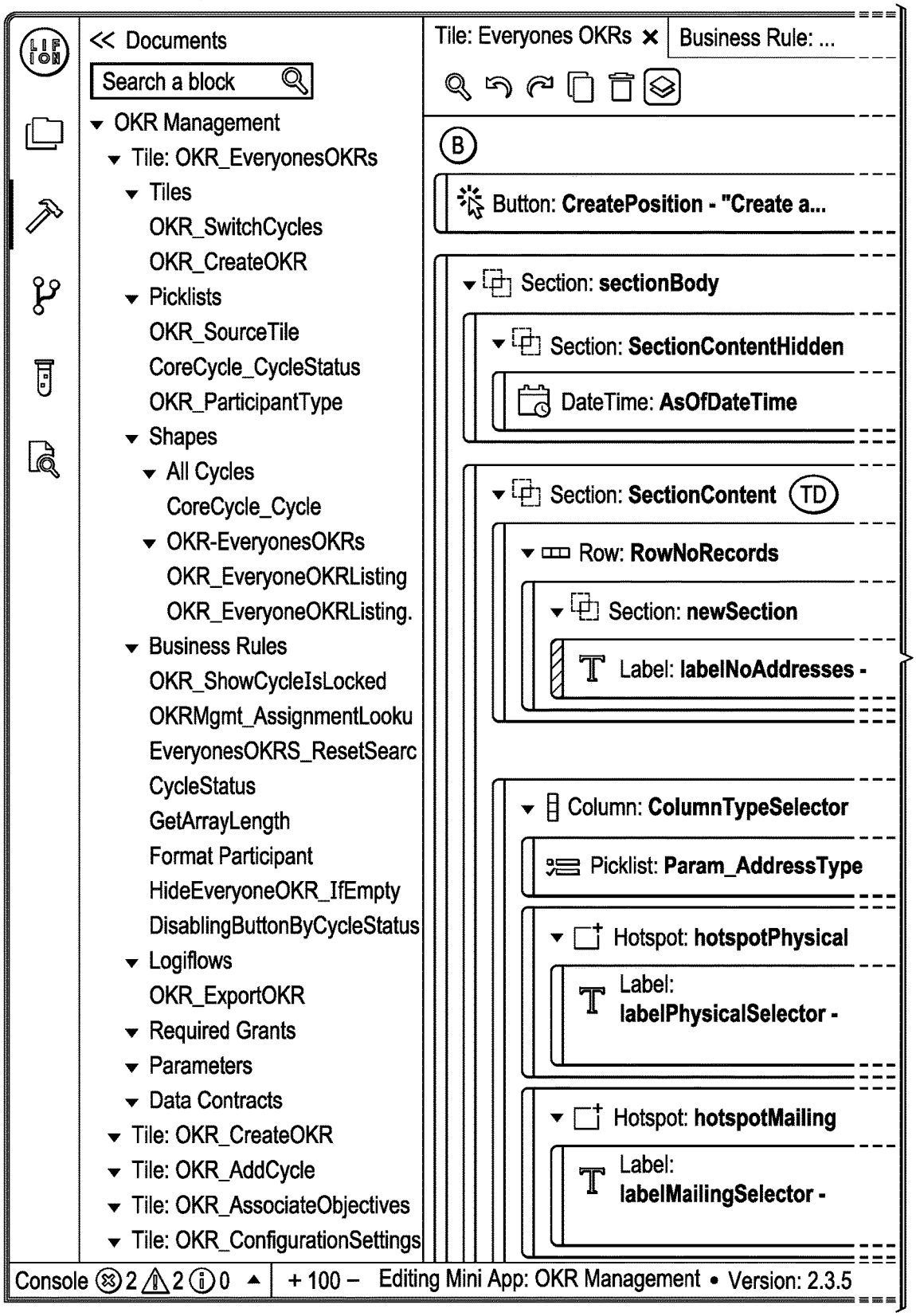
Documents
Search a block
OKR Management
Tile: OKR_EveryonesOKRs
Tiles
OKR_SwitchCycles
OKR_CreateOKR
Picklists
OKR_SourceTile
CoreCycle_CycleStatus
OKR_ParticipantType
Shapes
All Cycles
CoreCycle_Cycle
OKR-EveryonesOKRs
OKR_EveryoneOKRListing
OKR_EveryoneOKRListing.
Business Rules
OKR_ShowCycleIsLocked
OKRMgmt_AssignmentLooku
EveryonesOKRS_ResetSearc
CycleStatus
GetArrayLength
Format Participant
HideEveryoneOKR_IfEmpty
DisablingButtonByCycleStatus
Logiflows
OKR_ExportOKR
Required Grants
Parameters
Data Contracts
Tile: OKR_CreateOKR
Tile: OKR_AddCycle
Tile: OKR_AssociateObjectives
Tile: OKR_ConfigurationSettings
Tile: Everyones OKRs
Business Rule: ...
B
Button: CreatePosition - "Create a...
Section: sectionBody
Section: SectionContentHidden
DateTime: AsOfDateTime
Section: SectionContent
TD
Row: RowNoRecords
Section: newSection
Label: labelNoAddresses -
Column: ColumnTypeSelector
Picklist: Param_AddressType
Hotspot: hotspotPhysical
Label: labelPhysicalSelector -
Hotspot: hotspotMailing
Label: labelMailingSelector -
TO FIG. 9B
Console 2 2 0
+ 100 –
Editing Mini App: OKR Management • Version: 2.3.5

FIG. 9B

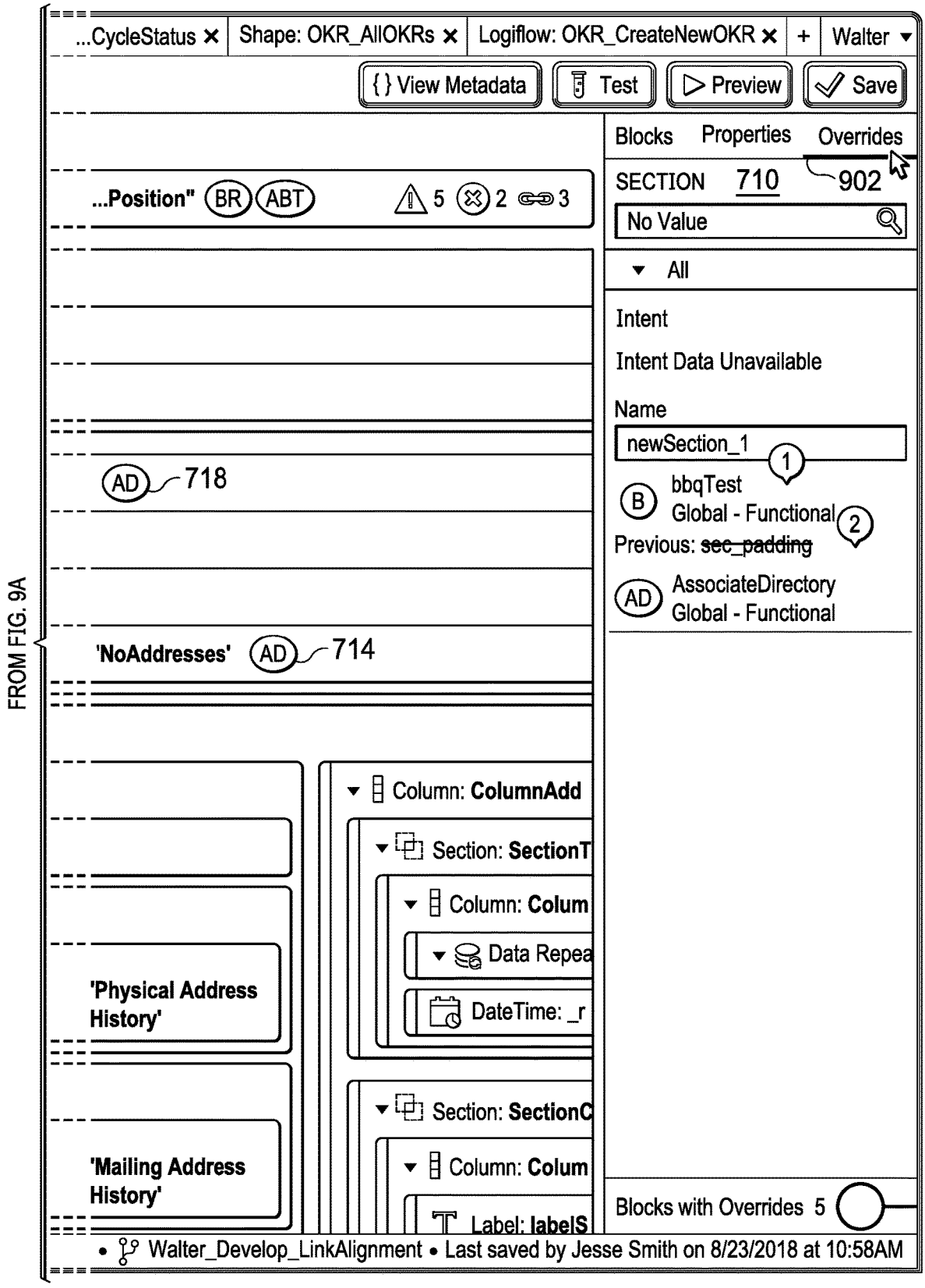
...CycleStatus
Shape: OKR_AllOKRs
Logiflow: OKR_CreateNewOKR
+
Walter
{} View Metadata
Test
Preview
Save
Blocks
Properties
Overrides
SECTION 710
902
No Value
All
Intent
Intent Data Unavailable
Name
newSection_1
1
bbqTest
Global - Functional
2
Previous: sec_padding
AssociateDirectory
Global - Functional
...Position"
BR
ABT
5
2
3
AD
718
'NoAddresses'
AD
714
FROM FIG. 9A
Column: ColumnAdd
Section: SectionT
Column: Colum
Data Repea
DateTime: _r
'Physical Address History'
Section: SectionC
Column: Colum
Label: labelS
'Mailing Address History'
Blocks with Overrides 5
Walter_Develop_LinkAlignment • Last saved by Jesse Smith on 8/23/2018 at 10:58AM

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FIG. 10A

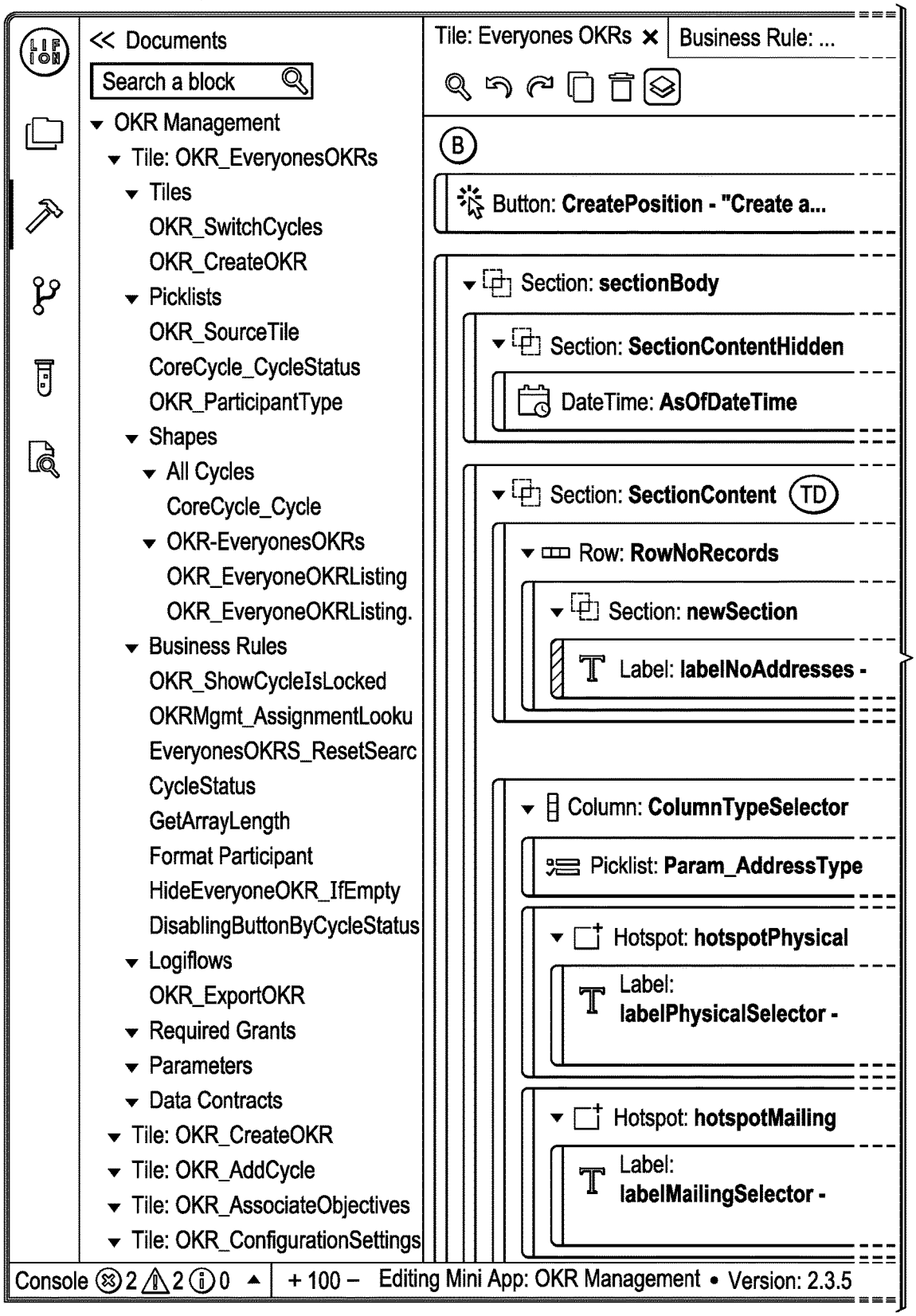
Documents
Search a block
OKR Management
Tile: OKR_EveryonesOKRs
Tiles
OKR_SwitchCycles
OKR_CreateOKR
Picklists
OKR_SourceTile
CoreCycle_CycleStatus
OKR_ParticipantType
Shapes
All Cycles
CoreCycle_Cycle
OKR-EveryonesOKRs
OKR_EveryoneOKRListing
OKR_EveryoneOKRListing.
Business Rules
OKR_ShowCycleIsLocked
OKRMgmt_AssignmentLooku
EveryonesOKRS_ResetSearc
CycleStatus
GetArrayLength
Format Participant
HideEveryoneOKR_IfEmpty
DisablingButtonByCycleStatus
Logiflows
OKR_ExportOKR
Required Grants
Parameters
Data Contracts
Tile: OKR_CreateOKR
Tile: OKR_AddCycle
Tile: OKR_AssociateObjectives
Tile: OKR_ConfigurationSettings
Tile: Everyones OKRs
Business Rule: ...
B
Button: CreatePosition - "Create a...
Section: sectionBody
Section: SectionContentHidden
DateTime: AsOfDateTime
Section: SectionContent
TD
Row: RowNoRecords
Section: newSection
Label: labelNoAddresses -
Column: ColumnTypeSelector
Picklist: Param_AddressType
Hotspot: hotspotPhysical
Label: labelPhysicalSelector -
Hotspot: hotspotMailing
Label: labelMailingSelector -
TO FIG. 10B
Console 2 2 0
+ 100 –
Editing Mini App: OKR Management • Version: 2.3.5

FIG. 10B

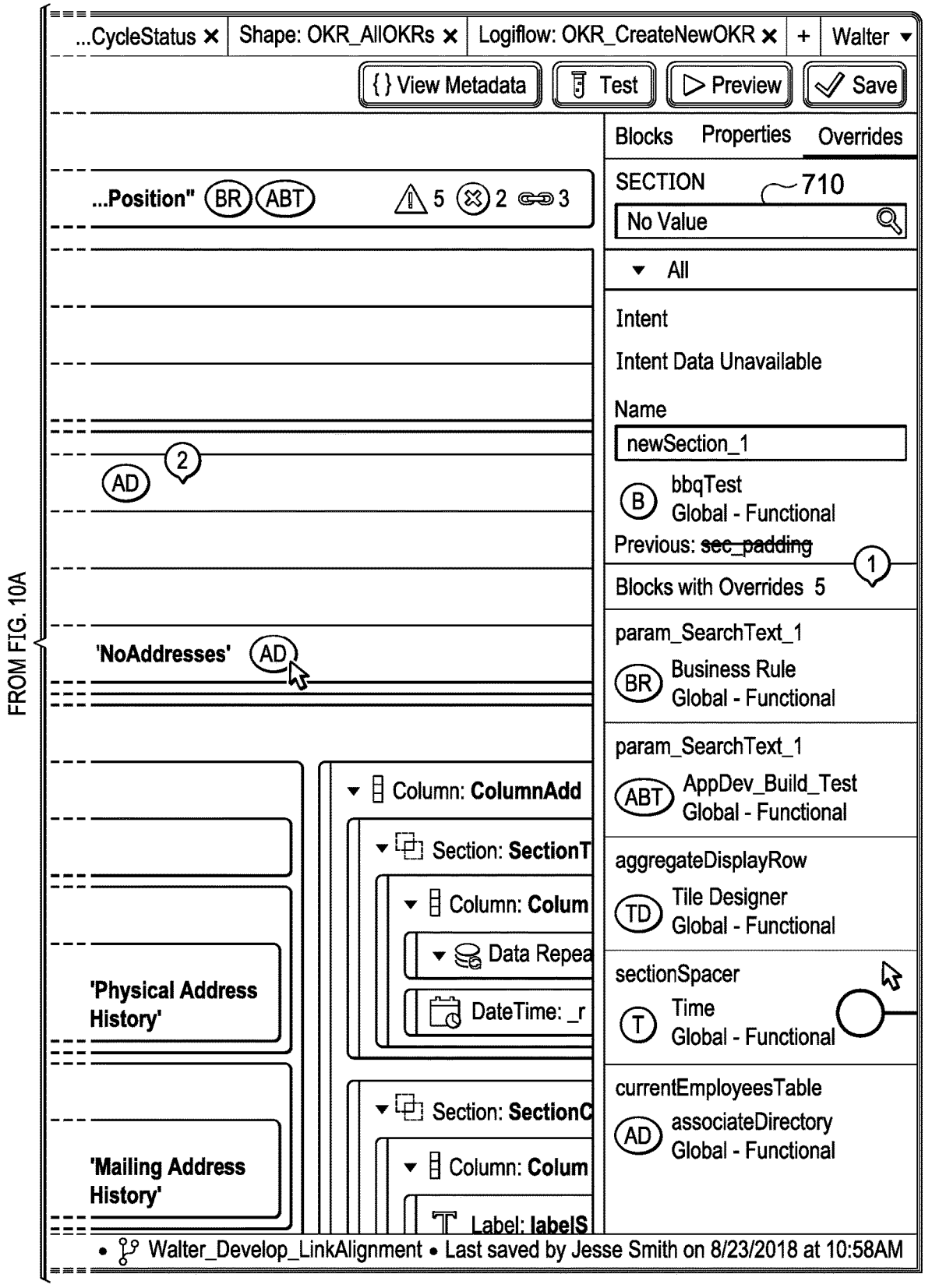
...CycleStatus
Shape: OKR_AllOKRs
Logiflow: OKR_CreateNewOKR
+
Walter
{} View Metadata
Test
Preview
Save
Blocks
Properties
Overrides
SECTION
710
No Value
All
Intent
Intent Data Unavailable
Name
newSection_1
bbqTest
Global - Functional
Previous: sec_padding
Blocks with Overrides 5
param_SearchText_1
Business Rule
Global - Functional
param_SearchText_1
AppDev_Build_Test
Global - Functional
aggregateDisplayRow
Tile Designer
Global - Functional
sectionSpacer
Time
Global - Functional
currentEmployeesTable
associateDirectory
Global - Functional
...Position"
BR
ABT
5
2
3
AD
2
'NoAddresses'
AD
'Physical Address History'
'Mailing Address History'
Column: ColumnAdd
Section: SectionT
Column: Colum
Data Repea
DateTime: _r
Section: SectionC
Column: Colum
Label: labelS
FROM FIG. 10A
Walter_Develop_LinkAlignment • Last saved by Jesse Smith on 8/23/2018 at 10:58AM

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FIG. 11A

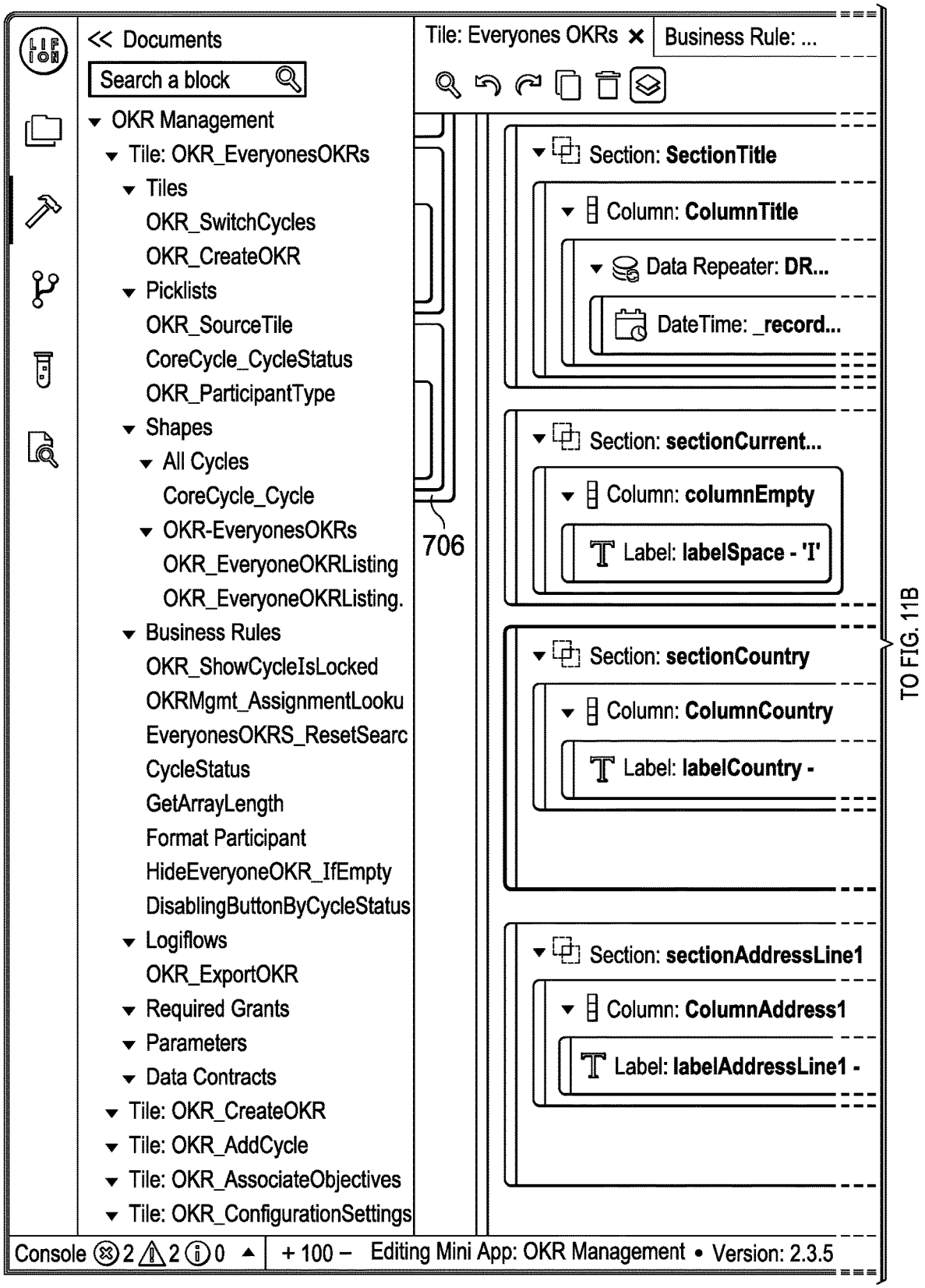
Documents
Search a block
OKR Management
Tile: OKR_EveryonesOKRs
Tiles
OKR_SwitchCycles
OKR_CreateOKR
Picklists
OKR_SourceTile
CoreCycle_CycleStatus
OKR_ParticipantType
Shapes
All Cycles
CoreCycle_Cycle
OKR-EveryonesOKRs
OKR_EveryoneOKRListing
OKR_EveryoneOKRListing.
Business Rules
OKR_ShowCycleIsLocked
OKRMgmt_AssignmentLooku
EveryonesOKRS_ResetSearc
CycleStatus
GetArrayLength
Format Participant
HideEveryoneOKR_IfEmpty
DisablingButtonByCycleStatus
Logiflows
OKR_ExportOKR
Required Grants
Parameters
Data Contracts
Tile: OKR_CreateOKR
Tile: OKR_AddCycle
Tile: OKR_AssociateObjectives
Tile: OKR_ConfigurationSettings
706
Tile: Everyones OKRs
Business Rule: ...
Section: SectionTitle
Column: ColumnTitle
Data Repeater: DR...
DateTime: _record...
Section: sectionCurrent...
Column: columnEmpty
Label: labelSpace - 'I'
Section: sectionCountry
Column: ColumnCountry
Label: labelCountry -
Section: sectionAddressLine1
Column: ColumnAddress1
Label: labelAddressLine1 -
TO FIG. 11B
Console 2 2 0
+ 100 –
Editing Mini App: OKR Management • Version: 2.3.5

FIG. 11B

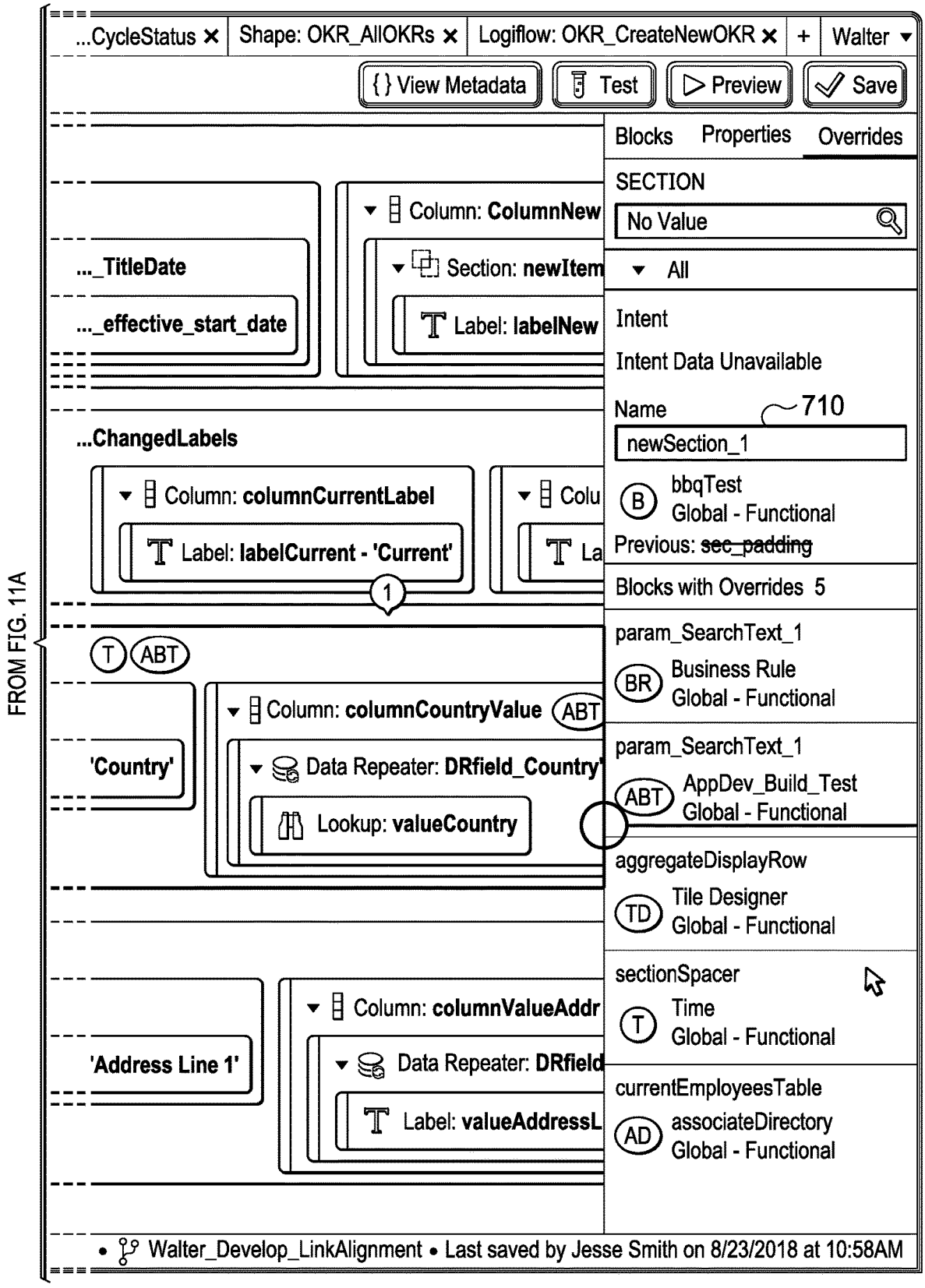
...CycleStatus
Shape: OKR_AllOKRs
Logiflow: OKR_CreateNewOKR
Walter
{} View Metadata
Test
Preview
Save
Blocks
Properties
Overrides
SECTION
No Value
All
Intent
Intent Data Unavailable
Name
710
newSection_1
bbqTest
Global - Functional
Previous: sec_padding
Blocks with Overrides 5
param_SearchText_1
Business Rule
Global - Functional
param_SearchText_1
AppDev_Build_Test
Global - Functional
aggregateDisplayRow
Tile Designer
Global - Functional
sectionSpacer
Time
Global - Functional
currentEmployeesTable
associateDirectory
Global - Functional
Column: ColumnNew
Section: newItem
Label: labelNew
..._TitleDate
..._effective_start_date
...ChangedLabels
Column: columnCurrentLabel
Label: labelCurrent - 'Current'
Column: columnCountryValue
Data Repeater: DRfield_Country
Lookup: valueCountry
'Country'
Column: columnValueAddr
Data Repeater: DRfield
Label: valueAddressL
'Address Line 1'
FROM FIG. 11A
Walter_Develop_LinkAlignment • Last saved by Jesse Smith on 8/23/2018 at 10:58AM

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FIG. 12A

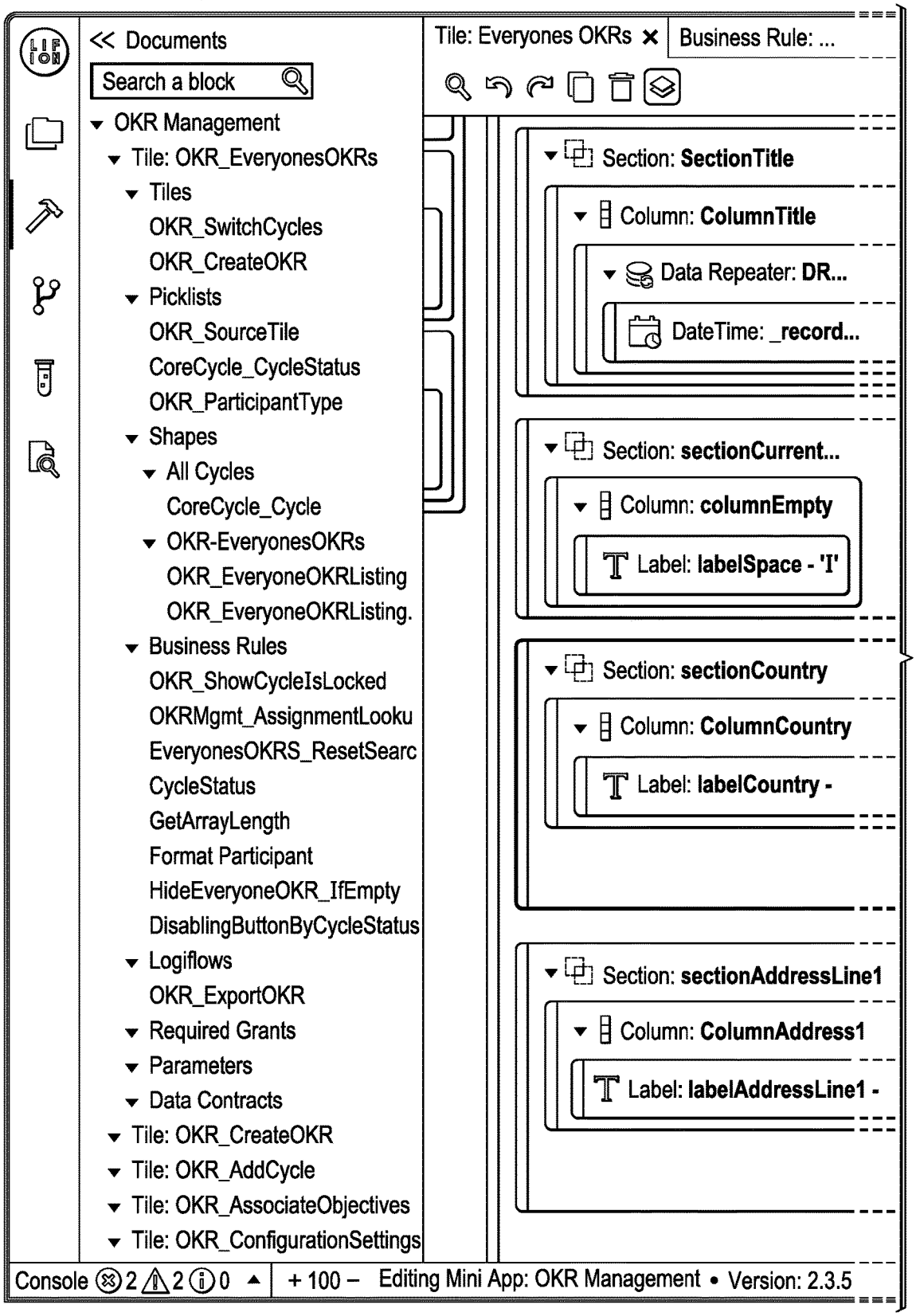

Documents
Search a block
OKR Management
Tile: OKR_EveryonesOKRs
Tiles
OKR_SwitchCycles
OKR_CreateOKR
Picklists
OKR_SourceTile
CoreCycle_CycleStatus
OKR_ParticipantType
Shapes
All Cycles
CoreCycle_Cycle
OKR-EveryonesOKRs
OKR_EveryoneOKRListing
OKR_EveryoneOKRListing.
Business Rules
OKR_ShowCycleIsLocked
OKRMgmt_AssignmentLooku
EveryonesOKRS_ResetSearc
CycleStatus
GetArrayLength
Format Participant
HideEveryoneOKR_IfEmpty
DisablingButtonByCycleStatus
Logiflows
OKR_ExportOKR
Required Grants
Parameters
Data Contracts
Tile: OKR_CreateOKR
Tile: OKR_AddCycle
Tile: OKR_AssociateObjectives
Tile: OKR_ConfigurationSettings
Tile: Everyones OKRs
Business Rule: ...
Section: SectionTitle
Column: ColumnTitle
Data Repeater: DR...
DateTime: _record...
Section: sectionCurrent...
Column: columnEmpty
Label: labelSpace - 'I'
Section: sectionCountry
Column: ColumnCountry
Label: labelCountry -
Section: sectionAddressLine1
Column: ColumnAddress1
Label: labelAddressLine1 -
Console 2 2 0
+ 100 –
Editing Mini App: OKR Management • Version: 2.3.5
TO FIG. 12B

FIG. 12B

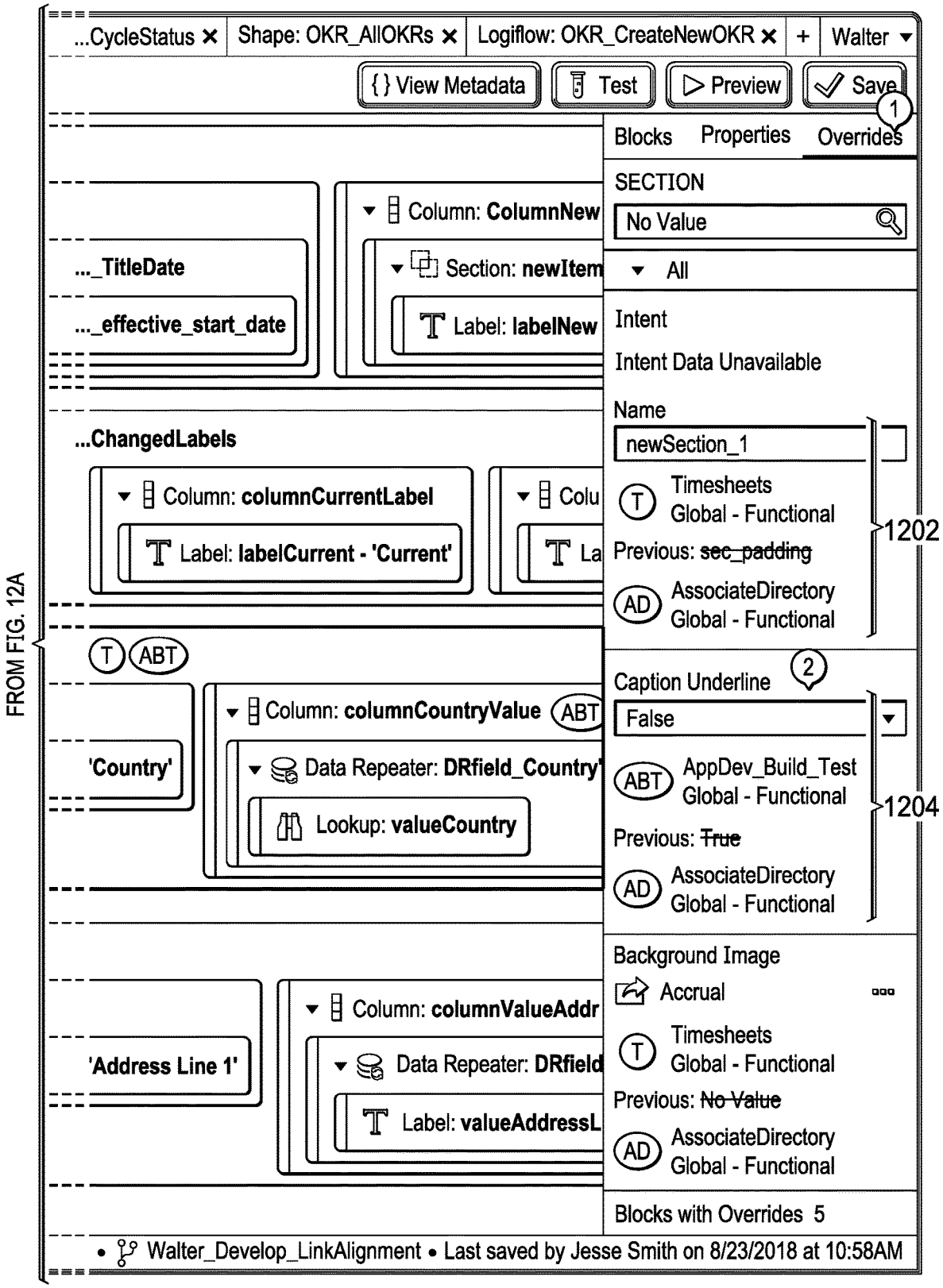

...CycleStatus
Shape: OKR_AllOKRs
Logiflow: OKR_CreateNewOKR
Walter
View Metadata
Test
Preview
Save
Blocks
Properties
Overrides
SECTION
No Value
All
Intent
Intent Data Unavailable
Name
newSection_1
Timesheets
Global - Functional
Previous: sec_padding
AssociateDirectory
Global - Functional
1202
Caption Underline
False
AppDev_Build_Test
Global - Functional
Previous: True
AssociateDirectory
Global - Functional
1204
Background Image
Accrual
Timesheets
Global - Functional
Previous: No Value
AssociateDirectory
Global - Functional
Blocks with Overrides 5
Column: ColumnNew
Section: newItem
Label: labelNew
...TitleDate
..._effective_start_date
...ChangedLabels
Column: columnCurrentLabel
Label: labelCurrent - 'Current'
Column: columnCountryValue
Data Repeater: DRfield_Country
Lookup: valueCountry
'Country'
Column: columnValueAddr
Data Repeater: DRfield
Label: valueAddressL
'Address Line 1'
FROM FIG. 12A
Walter_Develop_LinkAlignment • Last saved by Jesse Smith on 8/23/2018 at 10:58AM

FIG. 13A

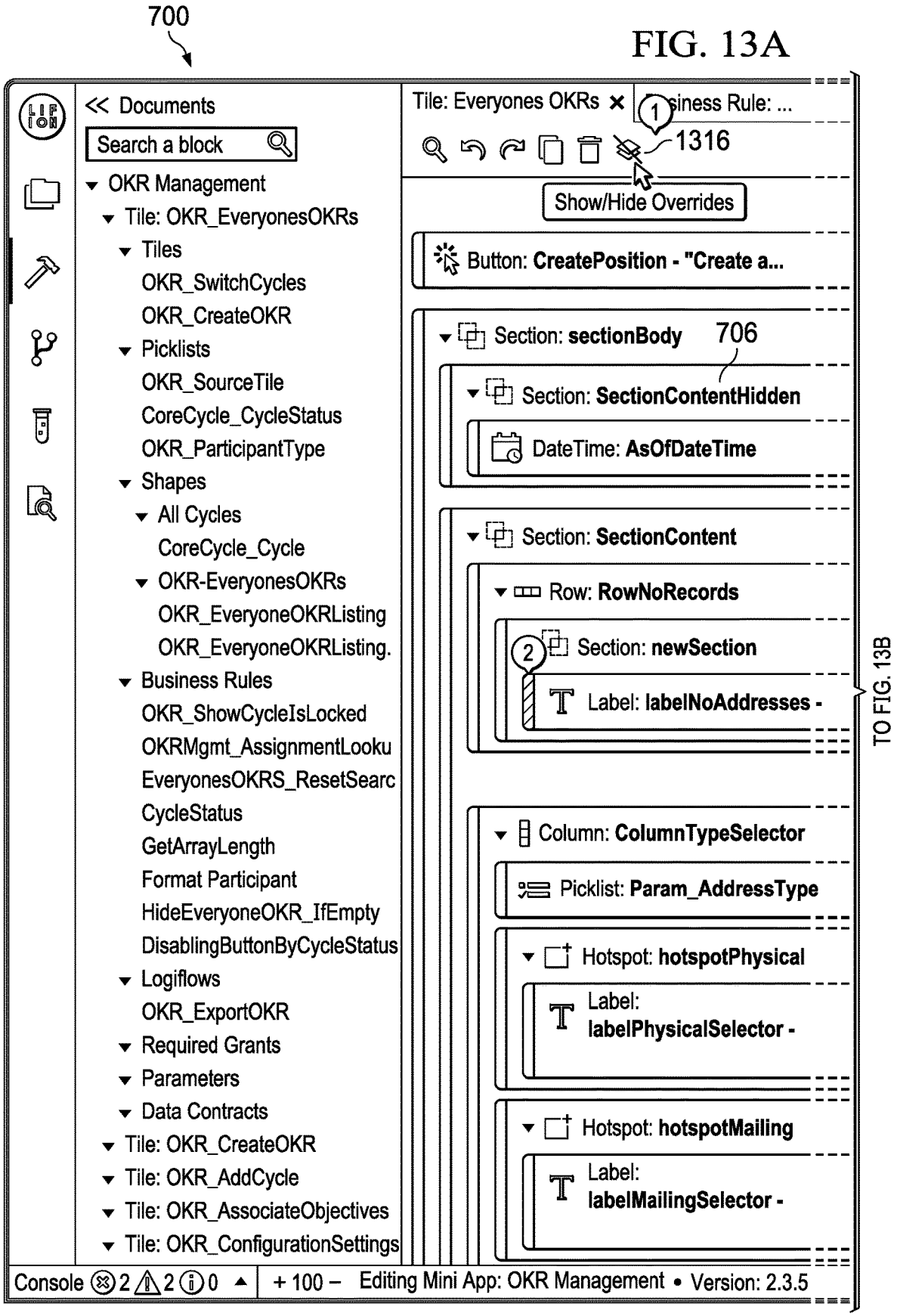
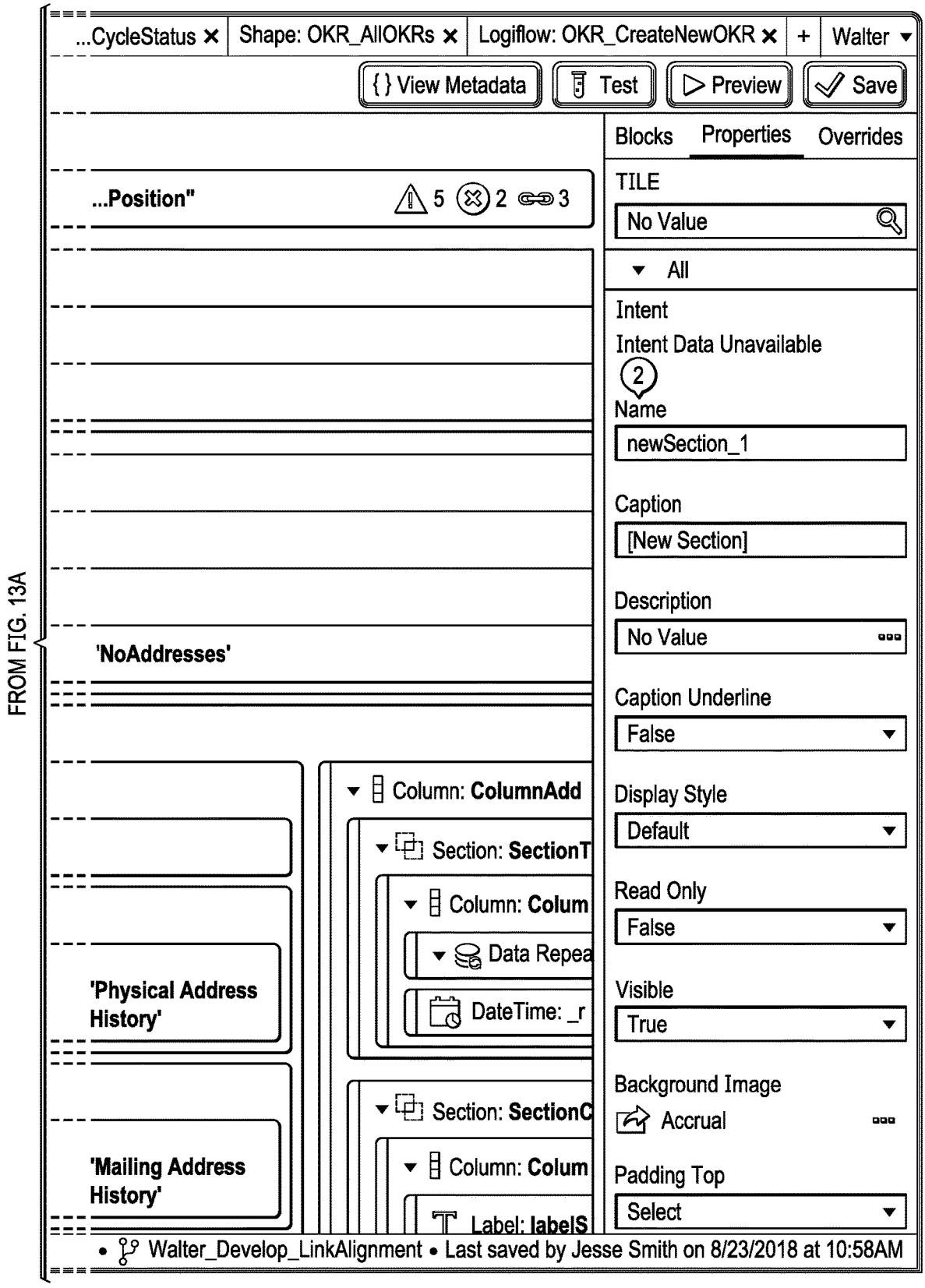

700
<< Documents
Search a block
OKR Management
Tile: OKR_EveryonesOKRs
Tiles
OKR_SwitchCycles
OKR_CreateOKR
Picklists
OKR_SourceTile
CoreCycle_CycleStatus
OKR_ParticipantType
Shapes
All Cycles
CoreCycle_Cycle
OKR-EveryonesOKRs
OKR_EveryoneOKRListing
OKR_EveryoneOKRListing.
Business Rules
OKR_ShowCycleIsLocked
OKRMgmt_AssignmentLooku
EveryonesOKRS_ResetSearc
CycleStatus
GetArrayLength
Format Participant
HideEveryoneOKR_IfEmpty
DisablingButtonByCycleStatus
Logiflows
OKR_ExportOKR
Required Grants
Parameters
Data Contracts
Tile: OKR_CreateOKR
Tile: OKR_AddCycle
Tile: OKR_AssociateObjectives
Tile: OKR_ConfigurationSettings
Tile: Everyones OKRs
siness Rule: ...
1
1316
Show/Hide Overrides
Button: CreatePosition - "Create a...
Section: sectionBody
706
Section: SectionContentHidden
DateTime: AsOfDateTime
Section: SectionContent
Row: RowNoRecords
2
Section: newSection
Label: labelNoAddresses -
Column: ColumnTypeSelector
Picklist: Param_AddressType
Hotspot: hotspotPhysical
Label: labelPhysicalSelector -
Hotspot: hotspotMailing
Label: labelMailingSelector -
TO FIG. 13B
Console 2 2 0
+ 100 –
Editing Mini App: OKR Management • Version: 2.3.5

FIG. 13B


...CycleStatus
Shape: OKR_AllOKRs
Logiflow: OKR_CreateNewOKR
+
Walter
{} View Metadata
Test
Preview
Save
Blocks
Properties
Overrides
FROM FIG. 13A
...Position"
5
2
3
'NoAddresses'
'Physical Address History'
'Mailing Address History'
Column: ColumnAdd
Section: SectionT
Column: Colum
Data Repea
DateTime: _r
Section: SectionC
Column: Colum
Label: labelS
TILE
No Value
All
Intent
Intent Data Unavailable
2
Name
newSection_1
Caption
[New Section]
Description
No Value
Caption Underline
False
Display Style
Default
Read Only
False
Visible
True
Background Image
Accrual
Padding Top
Select
Walter_Develop_LinkAlignment • Last saved by Jesse Smith on 8/23/2018 at 10:58AM

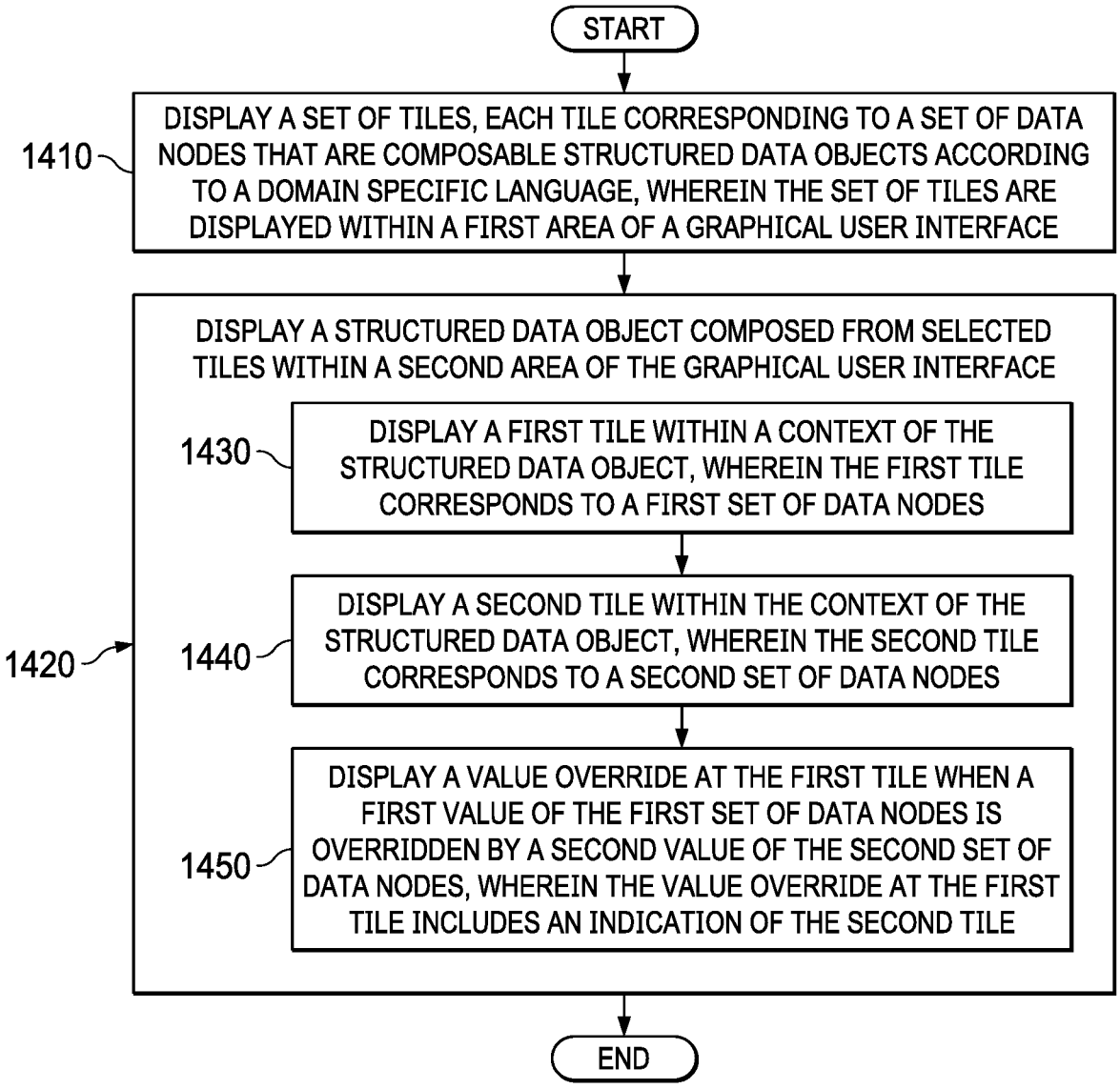

START
1410
DISPLAY A SET OF TILES, EACH TILE CORRESPONDING TO A SET OF DATA NODES THAT ARE COMPOSABLE STRUCTURED DATA OBJECTS ACCORDING TO A DOMAIN SPECIFIC LANGUAGE, WHEREIN THE SET OF TILES ARE DISPLAYED WITHIN A FIRST AREA OF A GRAPHICAL USER INTERFACE
1420
DISPLAY A STRUCTURED DATA OBJECT COMPOSED FROM SELECTED TILES WITHIN A SECOND AREA OF THE GRAPHICAL USER INTERFACE
1430
DISPLAY A FIRST TILE WITHIN A CONTEXT OF THE STRUCTURED DATA OBJECT, WHEREIN THE FIRST TILE CORRESPONDS TO A FIRST SET OF DATA NODES
1440
DISPLAY A SECOND TILE WITHIN THE CONTEXT OF THE STRUCTURED DATA OBJECT, WHEREIN THE SECOND TILE CORRESPONDS TO A SECOND SET OF DATA NODES
1450
DISPLAY A VALUE OVERRIDE AT THE FIRST TILE WHEN A FIRST VALUE OF THE FIRST SET OF DATA NODES IS OVERRIDDEN BY A SECOND VALUE OF THE SECOND SET OF DATA NODES, WHEREIN THE VALUE OVERRIDE AT THE FIRST TILE INCLUDES AN INDICATION OF THE SECOND TILE
END

FIG. 14

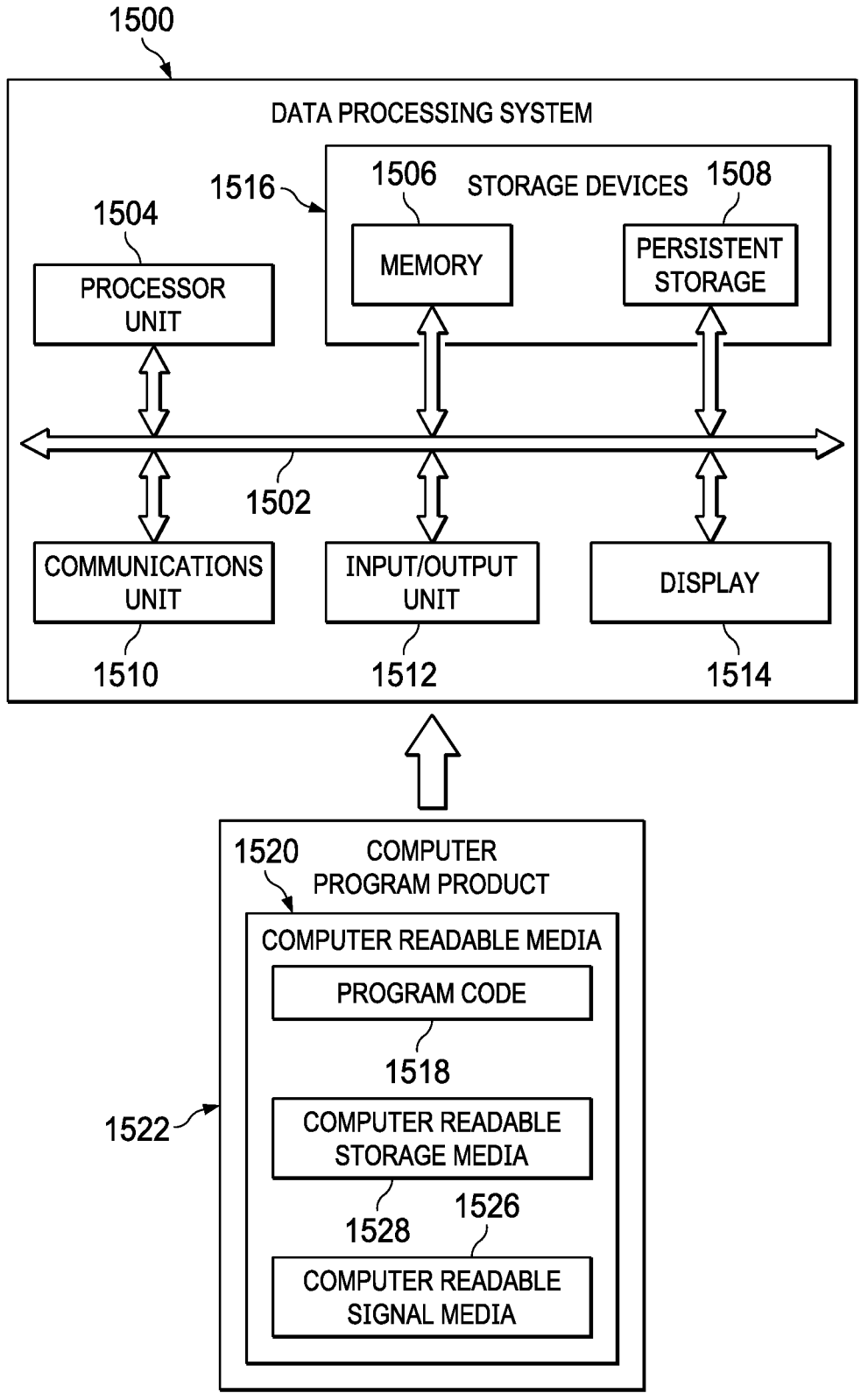

1500
DATA PROCESSING SYSTEM
1516
1506
STORAGE DEVICES
1508
1504
PROCESSOR UNIT
MEMORY
PERSISTENT STORAGE
1502
COMMUNICATIONS UNIT
INPUT/OUTPUT UNIT
DISPLAY
1510
1512
1514
1520
COMPUTER PROGRAM PRODUCT
COMPUTER READABLE MEDIA
PROGRAM CODE
1518
1522
COMPUTER READABLE STORAGE MEDIA
1528
1526
COMPUTER READABLE SIGNAL MEDIA

FIG. 15

USER INTERFACE ENGINE FOR MINIAPP DEVELOPMENT

BACKGROUND INFORMATION

1. Field

The present disclosure relates to methods and devices for creating special purpose computers whose hardware and programming enable transformation of a user interface and transformation of the function of a computer such that an untrained user may develop applications.

2. Background

Currently, when a new computer program is desired, a trained programmer uses one or more specialized computer languages to create code. The code instructs a computer to perform a desired function.

In most cases, even for simple programs, the programmer will have extensive training in order to write code that will be capable of creating the desired computer functionality. In the case of complex software, the programmer may need to develop an architecture for the computer program, and then write the code to implement the architecture. For a large project, an entire team of trained programmers may be needed to create the desired code.

Thus, the process of coding is complex, expensive, and, for some, individuals beyond their ability. For most individuals, the solution to providing a computer with a desired functionality is to purchase pre-programmed software to enable the desired functionality. For example, a user desiring to use a computer to perform business accounting may purchase an accounting program that provides a computer with the functionality of performing accounting procedures on the computer.

Nevertheless, a user may desire specialized functionality for the computer that is not currently for sale, or may desire to modify an existing program. However, unless that user is a trained programmer and is willing to expend the resources needed to code a new program, the user will not be able to use the desired specialized functionality on the computer.

SUMMARY

The illustrative embodiments provide for a method of composing a business rule. The method includes displaying, by a computer system, a set of tiles. Each tile corresponds to a set of data nodes that are composable structured data objects according to a domain-specific language. The set of tiles are displayed within a first area of a graphical user interface. The method further includes displaying, by the computer system, a structured data object composed from selected tiles within a second area of the graphical user interface. Displaying the structured data object includes displaying, in the second area of the graphical user interface, a first tile within a context of the structured data object. The first tile corresponds to a first set of data nodes. Displaying the structured data object includes displaying, in the second area of the graphical user interface, a second tile within the context of the structured data object. The second tile corresponds to a second set of data nodes. Displaying the structured data object includes displaying, in the second area of the graphical user interface, a value override at the first tile when a first value of the first set of data nodes is overridden by a second value of the second set of data nodes. The value override at the first tile includes an indication of the second tile.

The illustrative embodiments also provide for a non-transitory computer readable medium storing program code stored thereon. The program code includes code for displaying a set of tiles, each tile corresponding to a set of data nodes that are composable structured data objects according to a domain-specific language. The set of tiles are displayed within a first area of a graphical user interface. The program code includes code for displaying a structured data object composed from selected tiles within a second area of the graphical user interface. The program code for displaying the structured data object includes code for displaying, in the second area of the graphical user interface, a first tile within a context of the structured data object. The first tile corresponds to a first set of data nodes. The program code for displaying the structured data object includes code for displaying, in the second area of the graphical user interface, a second tile within the context of the structured data object. The second tile corresponds to a second set of data nodes. The program code for displaying the structured data object includes code for displaying, in the second area of the graphical user interface, a value override at the first tile when a first value of the first set of data nodes is overridden by a second value of the second set of data nodes. The value override at the first tile includes an indication of the second tile.

The illustrative embodiments provide for a computer system comprising a hardware processor and an integrated development environment in communication with the hardware processor. The integrated development environment is configured to display a set of tiles, each tile corresponding to a set of data nodes that are composable structured data objects according to a domain-specific language. The set of tiles are displayed within a first area of a graphical user interface. The integrated development environment is configured to display a structured data object composed from selected tiles within a second area of the graphical user interface. Displaying the structured data object includes displaying, in the second area of the graphical user interface, a first tile within a context of the structured data object. The first tile corresponds to a first set of data nodes. Displaying the structured data object includes displaying, in the second area of the graphical user interface, a second tile within the context of the structured data object. The second tile corresponds to a second set of data nodes. Displaying the structured data object includes displaying, in the second area of the graphical user interface, a value override at the first tile when a first value of the first set of data nodes is overridden by a second value of the second set of data nodes. The value override at the first tile includes an indication of the second tile.

BRIEF DESCRIPTION OF THE DRAWINGS

The novel features believed characteristic of the illustrative embodiments are set forth in the appended claims. The illustrative embodiments, however, as well as a preferred mode of use, further objectives and features thereof, will best be understood by reference to the following detailed description of an illustrative embodiment of the present disclosure when read in conjunction with the accompanying drawings, wherein:

FIG. **1** is an illustration of a diagram of a data processing environment in accordance with an illustrative embodiment;

FIG. **2** is a block diagram illustrating an application development system for a domain-specific language entirely composed of structured data objects, in accordance with an illustrative embodiment;

FIG. **3** an illustration of a block diagram of a structured data object in accordance with an illustrative embodiment;

FIG. **4** is an illustration of a block diagram of an example of an operation of a user interface engine shown in FIG. **1** in accordance with an illustrative embodiment;

FIG. **5** is a block diagram of an example of an operation of a user interface engine shown in FIG. **2**, in accordance with an illustrative embodiment;

FIG. **6** is a block diagram of an application development environment in accordance with an illustrative embodiment;

FIGS. **7**A-**7**B are an illustration of a graphical user interface having a focus sent to a particular data node in accordance with an illustrative embodiment;

FIGS. **8**A-**8**B are an illustration of a graphical user interface with a drop-down list in accordance with an illustrative embodiment;

FIGS. **9**A-**9**B are an illustration of a graphical user interface selecting a particular data node from a drop-down list in accordance with an illustrative embodiment; and

FIGS. **10**A-**10**B is an illustration of a graphical user interface is illustrated having appended a particular data node in accordance with an illustrative embodiment;

FIGS. **11**A-**11**B are an illustration of a flowchart for a process composing a business rule in accordance with an illustrative embodiment;

FIGS. **12**A-**12**B is an second illustration of a flowchart for a process composing a business rule in accordance with an illustrative embodiment;

FIGS. **13**A-**13**B is a third illustration of a flowchart for a process composing a business rule in accordance with an illustrative embodiment;

FIG. **14** is a flowchart of a method for composing a business rule according to an illustrative embodiment; and

FIG. **15** is an illustration of a block diagram of a data processing system in accordance with an illustrative embodiment.

DETAILED DESCRIPTION

The illustrative embodiments recognize and take into account that it is desirable to have a user interface engine to orchestrate development of mini-apps within an enterprise development environment. User interface atomic components are the basis for mini-app development. The user interface engine architecture allows for rapid creation of user interface atomic components and allows for codeless integration with responsive and adaptive mobile and touch support.

The illustrative embodiments also recognize and take into account that binding of customer data to a user browser in a way that makes sense for all different developer use cases is a difficult and previously unsolved problem. Complicating this problem is the interaction of server side resources with the interface components in the browser that the user manipulates, as well as with business rules specified by a user. Thus, the illustrative embodiments recognize and take into account that while a user may perceive a codeless, seamless, and integrated application development experience, the underlying functionality of the user interface engine is highly complex in order to enable that user experience.

With reference now to the figures and, in particular, with reference to FIG. **1**, an illustration of a diagram of a data processing environment is depicted in accordance with an illustrative embodiment. It should be appreciated that FIG. **1** is only provided as an illustration of one implementation and is not intended to imply any limitation, with regard to the environments in which the different embodiments may be implemented. Many modifications to the depicted environments may be made.

FIG. **1** depicts a pictorial representation of a network of data processing systems in which illustrative embodiments may be implemented. Network data processing system **100** is a network of computers in which the illustrative embodiments may be implemented. Network data processing system **100** contains network **102**, which is a medium used to provide communications links between various devices and computers connected together within network data processing system **100**. Network **102** may include connections, such as wire, wireless communication links, or fiber optic cables.

In the depicted example, server computer **104** and server computer **106** connect to network **102** along with storage unit **108**. In addition, client computers include client computer **110**, client computer **112**, and client computer **114**. Client computer **110**, client computer **112**, and client computer **114** connect to network **102**. These connections can be wireless or wired connections depending on the implementation. Client computer **110**, client computer **112**, and client computer **114** may be, for example, personal computers or network computers. In the depicted example, server computer **104** provides information, such as boot files, operating system images, and applications to client computer **110**, client computer **112**, and client computer **114**. Client computer **110**, client computer **112**, and client computer **114** are clients to server computer **104** in this example. Network data processing system **100** may include additional server computers, client computers, and other devices not shown.

Program code located in network data processing system **100** may be stored on a computer-recordable storage medium and downloaded to a data processing system or other device for use. For example, the program code may be stored on a computer-recordable storage medium on server computer **104** and downloaded to client computer **110** over network **102** for use on client computer **110**.

In the depicted example, network data processing system **100** is the Internet with network **102** representing a worldwide collection of networks and gateways that use the Transmission Control Protocol/Internet Protocol (TCP/IP) suite of protocols to communicate with one another. At the heart of the Internet is a backbone of high-speed data communication lines between major nodes or host computers consisting of thousands of commercial, governmental, educational, and other computer systems that route data and messages. Of course, network data processing system **100** also may be implemented as a number of different types of networks, such as, for example, an intranet, a local area network (LAN), or a wide area network (WAN). FIG. **1** is intended as an example, and not as an architectural limitation for the different illustrative embodiments.

The illustration of network data processing system **100** is not meant to limit the manner in which other illustrative embodiments can be implemented. For example, other client computers may be used in addition to or in place of client computer **110**, client computer **112**, and client computer **114** as depicted in FIG. **1**. For example, client computer **110**, client computer **112**, and client computer **114** may include a tablet computer, a laptop computer, and other suitable types of clients.

FIG. **2** is a block diagram illustrating an application development system for a domain-specific language entirely

composed of structured data objects depicted, in accordance with an illustrative embodiment. Application development system **200** may be used to manipulate composable data nodes to build at least one of business rules, mini-apps, and apps. Application development system **200** can be implemented in one or more of server computer **104**, server computer **106**, client computer **110**, client computer **112**, and client computer **114** of FIG. **1**.

As used herein, the phrase "at least one of," when used with a list of items, means different combinations of one or more of the listed items may be used and only one of each item in the list may be needed. In other words, "at least one of" means any combination of items and number of items may be used from the list, but not all of the items in the list are required. The item may be a particular object, thing, or a category.

For example, without limitation, "at least one of item A, item B, or item C" may include item A, item A and item B, or item B. This example also may include item A, item B, and item C or item B and item C. Of course, any combinations of these items may be present. In some illustrative examples, "at least one of" may be, for example, without limitation, two of item A; one of item B; and ten of item C; four of item B and seven of item C; or other suitable combinations.

User interface engine **202** is computer code, underlying data and structured data objects which provide underlying functionality and implementation capability for application designers using application development system **200**. Primarily, user interface engine **202** operates client-side, meaning that user interface engine **202** operates on a specific client user's computer, such as one or more of client computer **110**, client computer **112**, and client computer **114** of FIG. **1**. In one illustrative example, user interface engine **202** could be a web browser or an extension to a web browser.

Underlying the user interface, user interface engine **202** may include one or more modules. As depicted, user interface engine **202** includes tile renderer module **204**, data and metadata binding module **206**, and business rule and workflow module **208**. Each module may be considered a collection of software or computer code which implements the functionality of the module.

Tile renderer module **204** is computer code which computer **210** may use to render tiles on tangible user display device **212**. Tile renderer module **204** may receive input from the user, from data and metadata binding module **206**, and from business rule and workflow module **208** to change and manipulate both the functionality of computer **210**, which is used to execute tile renderer module **204**, as well as tangible user display device **212**, which is used to display rendered tiles.

Data and metadata binding module **206** is computer code which computer **210** may use to bind data and structured data objects to the user interface, possibly a browser, so that user interface engine **202** may keep track of all of the data and structured data objects used in executing business rules and workflows, as well as rendering tiles. Additional details regarding the functionality of data and structured data object binding module **206** is described below with respect to how data and structured data objects are used in user interface engine **202**.

Business rule and workflow module **208** is computer code which computer **210** may use to create, join, merge, or otherwise manipulate composable data nodes in order to create mini-apps, collections, and bundles. Business rule and workflow module **208** is the underlying code which allows a user to create mini-apps, collections, and bundles without the user having to code any of the software being developed. Using data and structured data objects tracked by data and metadata binding module **206**, the user can manipulate tiles rendered by tile renderer module **204**. Business rule and workflow module **208** uses these composable data nodes, together with work flows and business rules to create the mini-apps, collections, or bundles in a user-perceived codeless development environment.

Metadata interpreter **214** is hardware or software which is used to interpret or execute business rules in a business system. Metadata interpreter **214** can be software residing in a web browser on computer **210**. However, the illustrative embodiments are not necessarily limited to only client computers or web browsers.

Metadata interpreter **214** is a code interpreter designed for a domain-specific language entirely composed of structured data objects. In one illustrative example, metadata interpreter **214** takes the form of an abstract syntax tree (AST) interpreter with the exception that the abstract syntax tree (AST) structure is composed of well-defined data nodes constructs, joined together in a domain-specific language. Because the data node constructs are well-defined when they are constructed, metadata interpreter **214** executes the composition of structured data objects without compilation. Data node constructs are composed into well-defined structured data objects according to selected block types and properties, replacing the tokenization and parsing that would otherwise occur during compilation.

In some illustrative embodiments, user interface engine **202** may take advantage of some server side services operating on one or more server computers, such as server computer **216**. "Server side" means that computer **210** communicates with server computer **216**, possibly over a network such as the Internet. Server side resources are provided to support user interface engine **202**. While not always necessary for implementation of user interface engine **202**, server side resources can enhance the functionality of user interface engine **202**.

For example, the server side resources may include user interface engine orchestrator **218**. In some exemplary illustrative embodiments, user interface engine orchestrator **218** may be considered part of user interface engine **202** such that user interface engine **202** operates partially both on computer **210**, but also on one or more server computers, such as server computer **216**.

User interface engine orchestrator **218** may serve as a proxy to speed up processing of user interface engine **202**. User interface engine orchestrator **218** may retrieve structured data objects and then identify whether data queries are for customer data, business rules, or any other structured data objects. User interface engine orchestrator **218** may then request such data, objects, or code, from the data center operating server side. User interface engine orchestrator **218** may cache retrieved data, structured data objects, code, workflows, or objects to be sent back to user interface engine **202**.

Server side services may include other components other than user interface engine orchestrator **218**. For example, server side resources could include one or more metadata and DNA engines **220**, which can be used to manage or provide structured data objects for use in user interface engine **202**. Server side resources may also include one or more persistence engines **222**, which can be used to save work done using user interface engine **202**. Server side resources may also include business rule engine **224**, which may be used to create or store business rules that are used by

user interface engine **202** in the user-perceived codeless building of mini-apps, collections, and bundles.

Server side resources may also include workflow engine **226**, which may be used to create or store workflows that are used by user interface engine **202** in the user-perceived codeless building of mini-apps, collections, and bundles.

Server side resources may also include user interface test engine **228**, which may be used to test both the functionality of user interface engine **202**, possibly as well as the mini-apps, collections, and bundles created using user interface engine **202**.

With reference next to FIG. **3**, an illustration of a block diagram of a structured data object is depicted in accordance with an illustrative embodiment. Structured data object **300** is an example of a composition of well-defined data nodes that can be linked together according to a domain-specific language to create mini-apps, collections, or bundles in a user-perceived codeless development environment, such as application development system **200** of FIG. **2**.

Structured data object **300** includes data nodes **310**, **312**, and **314**. Data nodes **310**, **312**, and **314** are well-defined structured data objects that can be manipulated within data and metadata binding module **206** of FIG. **2** to create desired business rules. Tile renderer module **204** of user interface engine **202** may visually present data nodes **310**, **312**, and **314**, enabling the user to build different business rules, mini-apps and apps in application development system **200** of FIG. **2**. Each of data nodes **310**, **312**, and **314** correlate to one or more functions, which in turn can be interpreted by metadata interpreter **214** of FIG. **2** for implementing the corresponding business rule. The different permutations of the compositions of these functions, as well as differentiated input, enable the execution of the different business rule behaviors at runtime.

The functions of data nodes **310**, **312**, and **314** operate inside of a context defined at the beginning of the business rule execution step, which is the target object for all symbols defined in the course of the business rule execution, as well as for all input to and output from the business rule itself. In this manner, data nodes **310**, **312**, and **314** act as a configuration object to the code being executed, defining an execution context (or scope being executed against) to other joined data nodes.

For example, structured data object **300** further includes data node **316**. Data node **316** provides additional context for execution of related data node **312**. Specifically, data node **316** may indicate that data node **312**, as well as child data nodes thereof, should be interpreted within the context of data node **316**.

Structured data object **300** further includes data node **318**. Data node **318** provides additional context for execution of both related data node **312** and data node **316**. For example, data node **318** may indicate that information required for execution of data node **312** should be requested and received from one or more web services. Data node **318** requests and returns the same context updated with the information received through the web services.

Structured data object **300** further includes business rule node **320**. Business rule node **320** provides additional context for execution of related data node **314**. Specifically, business rule node **320** may indicate a consuming service for receipt of business rule output provided by related data node **314**. Business rule node **320** requests and returns information to a consuming service, such as a web page.

With reference next to FIG. **4**, an illustration of a block diagram of structured data objects that apply number of overrides at design time is depicted in accordance with an illustrative embodiment. Each of structured data objects **400**, **402**, and **404** is an example of a structured data object, such as structured data object **300** of FIG. **3**.

As depicted, structured data object **400** is a base level document, as indicated by data node **408**. Structured data object **400** is a composition of data nodes **408**, **410**, **412**, and **414** that are linked together according to a domain-specific language in a user-perceived codeless development environment, to create structured data object **400**.

Structured data object **402** is an override document, as indicated by data node **416** that may be linked to structured data object **400** according to a domain-specific language in a user-perceived codeless development environment. During interpretation, structured data object **400** is interpreted in conjunction with structured data object **402**, overriding one or more default values, properties, or combinations thereof, of the base level document. In an illustrative example, value overrides **418** and **420** respectively override one or more default values of data nodes **408** and **410** in the interpreted data object **430**. Property override **422** appends additional nodes within the interpreted data object **430**.

Structured data object **404** is an override document, as indicated by data node **424**. Structured data object **404** can be linked to structured data object **400** according to a domain-specific language in a user-perceived codeless development environment. During interpretation, structured data objects **400** and **402** are interpreted in conjunction with structured data object **404** overriding one or more default values, properties, or combinations thereof, of the base level document. In an illustrative example, value override **426** overrides one or more default values of data node **412** in the interpreted data object **430**. Property override **428** appends additional nodes within the interpreted data object **430**.

FIG. **5** is an illustration of a block diagram of an example of an operation of a user interface engine shown in FIG. **2**, in accordance with an illustrative embodiment. The example shown in FIG. **5** does not necessarily limit operation of user interface engine **202** as shown in FIG. **2**. Nevertheless, FIG. **5** may be read in conjunction with FIG. **2**.

In an illustrative embodiment, tile renderer module **204** in FIG. **2** may be used to generate graphical user interface **500**. Graphical user interface **500** may take the form of tiles **502** shown in web browser **504**. Each of tiles **502** may represent a building block. Alternatively, a tile may represent a mini-app, a collection, or even a bundle. Users may interact with graphical user interface **500**, triggering, for example, a "view actions" command **506**.

These actions are sent to dispatcher **508**, which may be part of user interface engine **202**, shown in FIG. **2**. Dispatcher **508** may send the actions to the business rule and workflow module via subscriptions registered with dispatcher **508**. Dispatcher **508** may also send server actions **510** sent by data center **512** to business rule and workflow module **208** in FIG. **2** for use in combination with the actions started by the user.

Business rule and workflow module **208** may run queries and apply business rules and other logic. Business rule and workflow module **208** may provide navigation **514**, data binding **516**, and execution by business rules and workflows executor **518**.

Data and metadata binding module **206** in FIG. **2** may apply changes to user interface state **520** held in memory. User interface state **520** may be held in a tree structure containing data **522**, metadata **524**, and tile state **526**. In turn, tile renderer module **204** in FIG. **2** may render graphical user interface **500**. Tile renderer module **204** may listen to state

changes in the tree structure and efficiently update only data **522** and metadata **524** that need re-rendering.

Graphical user interface **500** enables users with little or no background in computer software development to simply drag-and-drop files that contain prebuilt features onto a canvas and start building applications. However, as a user's efficiency progresses over time, this repetitive drag-and-drop interaction becomes a tedious process in application development in low-code development environments.

With reference next to FIG. **6**, a block diagram of an application development environment is depicted according to an illustrative example. Application development environment **600** includes application development system **602**. Application development system **602** is an example of application development system **200** of FIG. **2**. Application development system **602** can be implemented in computer system **604**, which can be one or more of server computer **104**, server computer **106**, client computer **110**, client computer **112**, and client computer **114** of FIG. **1**.

Application development system **602** may be implemented in software, hardware, firmware, or a combination thereof. When software is used, the operations performed by application development system **602** may be implemented in program code configured to run on hardware, such as a processor unit. When firmware is used, the operations performed by application development system **602** may be implemented in program code and data and stored in persistent memory to run on a processor unit. When hardware is employed, the hardware may include circuits that operate to perform the operations in application development system **602**.

In the illustrative examples, the hardware may take the form of a circuit system, an integrated circuit, an application-specific integrated circuit (ASIC), a programmable logic device, or some other suitable type of hardware configured to perform a number of operations. With a programmable logic device, the device may be configured to perform the number of operations. The device may be reconfigured at a later time or may be permanently configured to perform the number of operations. Programmable logic devices include, for example, a programmable logic array, programmable array logic, a field programmable logic array, a field programmable gate array, and other suitable hardware devices. Additionally, the processes may be implemented in organic components integrated with inorganic components and may be comprised entirely of organic components, excluding a human being. For example, the processes may be implemented as circuits in organic semiconductors.

In one illustrative example, application development system **602** displays set of tiles **606**. Set of tiles **606** is an example of tiles **502** of FIG. **5**, wherein each tile represents data node, mini-app, collection, or bundle. Each tile of set of tiles **606** corresponds to a different set of data nodes **608**. Data node **608** are examples of data nodes such as data nodes **310-320** of FIG. **3**. Data nodes **608** are composable into structured data objects, such as structured data object **300** of FIG. **3**, according to a domain-specific language. Set of tiles **606** are displayed within a first area **610** of a graphical user interface **612**.

Application development system **602** displays structured data object **614**. Structured data object **614** is an example of structured data object **300** of FIG. **3**. Structured data object **614** is composed from selected tiles, selected from a set of tiles **606**. As depicted, structured data object **614** is composed of first tile **616** and second tile **618**. Application development system **602** displays structured data object **614** in second area **620** of the graphical user interface **612**.

In an illustrative example, displaying the structured data object **614** includes displaying a first set of data nodes **622** within a context **624** of the structured data object **614**. First set of data nodes **622** corresponds to first tile **616**.

Continuing with the current illustrative example, displaying the structured data object **614** also includes displaying second set of data nodes **626** within a context **624** of the structured data object **614**. Second set of data nodes **626** corresponds to a second tile **618**.

Continuing with the current illustrative example, displaying the structured data object **614** also includes displaying a value override **628** in association with the first set of data nodes **622** when a first value of the first set of data nodes **622** is overridden by a second value of the second set of data nodes **626**, wherein the value override **628** at the first tile includes an indicator of the second tile **618**.

In one illustrative example, displaying a structured data object **614** includes displaying the first set of data nodes **622** in association with first sidebar **630**. Application development system **602** displays first sidebar **630**, having a first color.

Continuing with the current illustrative example, displaying the structured data object **614** also includes determining when the second set **626** of data nodes appends additional properties to the first set of nodes **622**. For example, second set of data nodes may be a contextual overrides, such as one of override structures, **404** or **406** of FIG. **4**, that supersedes default properties of first set of data nodes **622**. In this illustrative example, the second set of data nodes appends additional properties, in the form of one or more additional data nodes, to one or more of the first set of nodes **622**. when the second set of data nodes **626** appends additional properties to the first set of nodes **622**, application development system **602** displays property override **632** in association with the second set of data nodes **626**. In one illustrative example, application development system **602** displays property override **632** in the form of second sidebar **634**, having a second color. The second color of second sidebar **634** is different than the first color of first sidebar **630**.

In one illustrative example, graphical user interface **612** includes override toggle **636**. Override toggle **636** is a control element. As used herein, a control is a graphical and/or functional element that can be reused across graphical user interface (GUI) applications and which the user can select and activate to get additional information. A control, in a graphical user interface, is an object on the screen that can be manipulated by the user to perform some action.

Continuing with the current example, when user input is received that selects override toggle **636**, application development system **602** removes the value override **628** from the second area of the graphical user interface **612**. However, selection of the override toggle **636** control does not cause application development system **602** to remove the property override **632** from the second area **620** of the graphical user interface **612**.

In one illustrative example, each of the data nodes displayed in second area **620** is also a control element which the user can select and activate to get additional information about the associated data node. For example, user input can be received that selects one of first set of data nodes **622** in the second area **620** of the graphical user interface **612**. In response, application development system **602** displays set of overrides **638** applied to the selected one of first set of data nodes **622**. Set of overrides **638** is displayed within a

third area **640** of the graphical user interface **612**. Override **642** is one of set of overrides **638**.

As depicted, override **642** includes overriding tile **644** and overridden tile **646**. Overriding tile **644** is an indication of which a set of tiles **606** is overriding overridden tile **646**. Overriding tile **644** may include an indication of the superseding property or value. Overridden tile **646** is an indication of which a set of tiles **606** is being overridden by overriding tile **644**. Overridden tile **646** may include an indication of the original property or value.

For example, when second set of data nodes **626** overrides one or more properties or values of first set of data nodes **622**, overriding tile **644** can include an indication of second tiles **618**, as well as the particular properties or values of second set of data nodes **626** that are overriding the properties or values of first set of data nodes **622**. Overridden tile **606** can include an indication of first tile **616**, as well as the particular properties or values of first set of data nodes **622** that are superseded by the properties or values of second set of data nodes **626**.

In one illustrative example, user input can be received that selects one of set of override **638** in third area **640** of the graphical user interface **612**. In response, application development system **602** focuses second area **620** of the graphical user interface **612** on a corresponding data node that includes the value for the selected override. For example, in response to receiving user input that selects override **642**, application development system **602** focuses second area **620** on a corresponding one of second set of data nodes **626** that includes the value for override **642**.

As a result, when implemented in a computer system, application development system **602** operates as a special purpose computer system in which integrated development environment **602** enables operator **621** to more quickly compose structured data object **614**. Integrated development environment **602** enables operator **621** to more easily determine overriding properties and values as well as the tiles that are applying those overriding properties and values. Therefore, application development system **602** transforms a computer system into a special purpose computer system as compared to currently available general computer systems that do not have application development system **602**.

With reference next to FIG. **7**, a graphical user interface for composing structured data objects according to a domain-specific language is depicted according to an illustrative example. Graphical user interface **700** is an example of graphical user interface **612** of FIG. **6**.

As depicted, graphical user interface **700** includes a first area **702**. First area **702** is an example of first area **610** of FIG. **6**. First area **702** displays tiles **704**. Tiles **704** is an example set of tiles **606**, shown in block form in FIG. **6**.

As depicted, graphical user interface **700** includes a second area **706**. Second area **706** is an example of second area **620** of FIG. **6**. Second area **706** displays a plurality of data nodes that have been linked together to form a structured data object **708** according to a domain-specific language. Dragging tiles from a first area **702** to second area **706** appends the corresponding set of data nodes into a structured data object **708** according to the domain-specific language.

As depicted, graphical user interface **700** includes third area **710**. Third area **710** is an example of third area **640** of FIG. **6**. Third area **710** displays properties and values for a data node selected from second area **706**.

As depicted, third area **710** displays top-level document properties for structured data object **708**. Top-level document properties can be displayed by default, such as, before a particular data node is selected from second area **706**.

As depicted, second area **706** includes property override **710**, indicating that an additional property has been appended to data node **712**. In an illustrative example, Overriding by adding a new block is identified by sidebar **713** displayed using different color. Sidebar **713** is an example of second sidebar **634** of FIG. **6**. Overriding by adding a new block may additionally be identified by a specific indication **714** of the tile that is making the override.

As depicted, second area **706** includes value override **716**, indicating that a default value of data node **712** has been changed. In an illustrative example, Overriding by changing a value inside an existing block is identified by a specific indication **718** of the tile that is making the override.

With reference next to FIG. **8**, graphical user interface **700** is illustrated having a tooltip pop-up displayed in association with a particular data node according to an illustrative example. In an illustrative example, graphical user interface **700** displays pop-up **802** in response to receiving user input interacting with specific indicator **804**. In an illustrative example, graphical user interface **700** displays pop-up **806** in response to receiving user input interacting with specific indicator **804**. In one illustrative example, pop-ups **802** and **806** are displayed in response to user input that hovers a pointer the respective control.

With reference next to FIG. **9**, graphical user interface **700** is illustrated displaying properties and values for a selected data node according to an illustrative example. Responsive to user input that selects override tab **902**, all overrides that are applied to a selected block are displayed in third area **710**. In an illustrative example, corresponding overrides can be displayed in third area **710** in response to user input selecting a particular specific indication, such as specific indicator **714** or **718**. As depicted, each override displayed in third area **710** includes an indication of the overriding tile, the overridden tile, and the affected properties and values.

With reference next to FIG. **10**, graphical user interface **700** is illustrated displaying overridden blocks according to an illustrative example. Responsive to user input that selects an overridden tile from third area **710**, graphical user interface subdivides third area **710** to display a list of all sub-blocks with overrides. Each override includes the name of the tile that is overriding the block, as well as the overriding property or value. As depicted, multiple tiles that are overriding a particular block are listed separately.

With reference next to FIG. **11**, graphical user interface **700** is illustrated displaying a user interaction with and overridden block according to an illustrative example.

Responsive to user input that selects and overridden block from third area **710**, graphical user interface **700** auto-scrolls second area **706** to the corresponding block. Graphical user interface **700** may additionally indicate the corresponding block in second area **706**, such as by highlighting or otherwise graphically indicating the corresponding block.

With reference next to FIG. **12**, graphical user interface **700** is illustrated showing overridden properties within a selected block. Responsive to user input that selects a block from third area **710**, graphical user interface **700** displays properties **1202**, **1204** that are overridden inside the selected block. Properties that are overridden inside the block are listed with new values applied by the overriding tile, and previous values of the overridden tile.

With reference next to FIG. **13**, graphical user interface **700** is illustrated displaying a user interaction with override toggle **1310**. Override toggle **1310** is an example of override toggle **636**, shown in block form in FIG. **6**. Responsive to

receiving user input that selects override toggle **1310**, graphical user interface **700** hides the specific indicators displayed in second area **706** and third area **710**. In one illustrative example, in response to a selection of an override toggle control, graphical user interface **700** the value override from the second area **706** of the graphical user interface **700**. However, the selection of the override toggle **1310** does not remove the property override from the second area **706** of the graphical user interface **700**.

With reference next to FIG. **14**, a flowchart of a method for composing a business rule is depicted according to an illustrative embodiment. Process **1400** is a software process implemented using one or more components of application development environment **600** of FIG. **6**.

The process displays a set of tiles within a first area of a graphical user interface (step **1410**). Each tile corresponds to a set of data nodes that are composable structured data objects according to a domain-specific language.

The process displays a structured data object within a second area of the graphical user interface (step **1420**). The structured data object is composed from tiles selected from the first area of the graphical user interface.

In an illustrative example, displaying the structured data object includes displaying a first tile within a context of the structured data object (step **1430**). The first tile corresponds to a first set of data nodes.

In an illustrative example, displaying the structured data object includes displaying a second tile within the context of the structured data object (step **1440**). The second tile corresponds to a second set of data nodes.

In an illustrative example, displaying structured data object includes displaying a value override at the first tile when a first value of the first set of data nodes is overridden by a second value of the second set of data nodes (step **1450**), with the process terminating thereafter. The value override at the first tile includes an indication of the second tile.

Turning now to FIG. **15**, an illustration of a block diagram of a data processing system is depicted in accordance with an illustrative embodiment. Data processing system **1500** may be used to implement one or more computers, such as server computers **104**, **106** and client computers **110**, **112**, **114** in FIG. **1**.

In this illustrative example, data processing system **1500** includes communications framework **1502**, which provides communications between processor unit **1504**, memory **1506**, persistent storage **1508**, communications unit **1510**, input/output unit **1512**, and display **1514**. In this example, communications framework **1502** may take the form of a bus system.

Processor unit **1504** serves to execute instructions for software that may be loaded into memory **1506**. Processor unit **1504** may be a number of processors, a multi-processor core, or some other type of processor, depending on the particular implementation. In an embodiment, processor unit **1504** comprises at least one of a multicore processor, a central processing unit (CPU), a graphics processing unit (GPU), a physics processing unit (PPU), a digital signal processor (DSP), a network processor, or some other suitable type of processor.

Memory **1506** and persistent storage **1508** are examples of storage devices **1516**. A storage device is any piece of hardware that is capable of storing information, such as, for example, without limitation, at least one of data, program code in functional form, or other suitable information either on a temporary basis, a permanent basis, or both on a temporary basis and a permanent basis. Storage devices **1516** may also be referred to as computer-readable storage devices in these illustrative examples. Memory **1506**, in these examples, may be, for example, a random access memory or any other suitable volatile or non-volatile storage device. Persistent storage **1508** may take various forms, depending on the particular implementation.

For example, persistent storage **1508** may contain one or more components or devices. For example, persistent storage **1508** may be a hard drive, a flash memory, a rewritable optical disk, a rewritable magnetic tape, or some combination of the above. The media used by persistent storage **1508** also may be removable. For example, a removable hard drive may be used for persistent storage **1508**. Communications unit **1510**, in these illustrative examples, provides for communications with other data processing systems or devices. In these illustrative examples, communications unit **1510** is a network interface card.

Input/output unit **1512** allows for input and output of data with other devices that may be connected to data processing system **1500**. For example, input/output unit **1512** may provide a connection for user input through at least one of a keyboard, a mouse, or some other suitable input device. Further, input/output unit **1512** may send output to a printer. Display **1514** provides a mechanism to display information to a user.

Instructions for at least one of the operating system, applications, or programs may be located in storage devices **1516**, which are in communication with processor unit **1504** through communications framework **1502**. The processes of the different embodiments may be performed by processor unit **1504** using computer-implemented instructions, which may be located in a memory, such as memory **1506**.

These instructions are referred to as program code, computer-usable program code, or computer-readable program code that may be read and executed by a processor in processor unit **1504**. The program code in the different embodiments may be embodied on different physical or computer-readable storage media, such as memory **1506** or persistent storage **1508**.

Program code **1518** is located in a functional form on computer-readable media **1520** that is selectively removable and may be loaded onto or transferred to data processing system **1500** for execution by processor unit **1504**. Program code **1518** and computer-readable media **1520** form computer program product **1522** in these illustrative examples. In one example, computer-readable media **1520** may be computer-readable storage media **1524** or computer-readable signal media **1526**.

In these illustrative examples, computer-readable storage media **1524** is a physical or tangible storage device used to store program code **1518** rather than a medium that propagates or transmits program code **1518**. Alternatively, program code **1518** may be transferred to data processing system **1500** using computer-readable signal media **1526**.

Computer-readable signal media **1526** may be, for example, a propagated data signal containing program code **1518**. For example, computer-readable signal media **1526** may be at least one of an electromagnetic signal, an optical signal, or any other suitable type of signal. These signals may be transmitted over at least one of communications links, such as wireless communications links, optical fiber cable, coaxial cable, a wire, or any other suitable type of communications link.

The different components illustrated for data processing system **1500** are not meant to provide architectural limitations to the manner in which different embodiments may be implemented. The different illustrative embodiments may be

implemented in a data processing system including components in addition to or in place of those illustrated for data processing system **1500**. Other components shown in FIG. **15** can be varied from the illustrative examples shown. The different embodiments may be implemented using any hardware device or system capable of running program code **1518**.

The flowcharts and block diagrams in the different depicted embodiments illustrate the architecture, functionality, and operation of some possible implementations of apparatuses and methods in an illustrative embodiment. In this regard, each block in the flowcharts or block diagrams may represent at least one of a module, a segment, a function, or a portion of an operation or step. For example, one or more of the blocks may be implemented as program code.

In some alternative implementations of an illustrative embodiment, the function or functions noted in the blocks may occur out of the order noted in the figures. For example, in some cases, two blocks shown in succession may be performed substantially concurrently, or the blocks may sometimes be performed in the reverse order, depending upon the functionality involved. Also, other blocks may be added in addition to the illustrated blocks in a flowchart or block diagram.

The description of the different illustrative embodiments has been presented for purposes of illustration and description and is not intended to be exhaustive or limited to the embodiments in the form disclosed. The different illustrative examples describe components that perform actions or operations. In an illustrative embodiment, a component may be configured to perform the action or operation described. For example, the component may have a configuration or design for a structure that provides the component an ability to perform the action or operation that is described in the illustrative examples as being performed by the component. Many modifications and variations will be apparent to those of ordinary skill in the art. Further, different illustrative embodiments may provide different features as compared to other desirable embodiments. The embodiment or embodiments selected are chosen and described in order to best explain the principles of the embodiments, the practical application, and to enable others of ordinary skill in the art to understand the disclosure for various embodiments with various modifications as are suited to the particular use contemplated.

What is claimed is:

1. A method for composing a business rule, the method comprising:

displaying, by a computer system, a set of tiles, each tile corresponding to a set of data nodes that are composable structured data objects according to a domain-specific language, wherein the set of tiles are displayed within a first area of a graphical user interface; and

displaying, by the computer system, a structured data object composed from selected tiles within a second area of the graphical user interface, wherein displaying the structured data object includes:

displaying, in the second area of the graphical user interface, a first tile within a context of the structured data object, wherein the first tile corresponds to a first set of data nodes;

displaying, in the second area of the graphical user interface, a second tile within the context of the structured data object, wherein the second tile corresponds to a second set of data nodes;

displaying, in the second area of the graphical user interface, a value override at the first tile when a first value of the first set of data nodes is overridden by a second value of the second set of data nodes, wherein the value override at the first tile includes an indication of the second title;

displaying the first tile in association with a first sidebar having a first color;

displaying properties indicated by the first set of data nodes in association with sidebars having the first color;

appending, by the second set of data nodes, additional properties to a first set of nodes;

displaying the second tile in association with a property override, wherein the property override is a second sidebar having a second color; and

in response to a selection of an override toggle control, removing the value override from the second area of the graphical user interface, wherein the selection of the override toggle control does not remove the property override from the second area of the graphical user interface.

2. The method of claim **1**, further comprising:

in response to a selection of a first data node in the second area of the graphical user interface, displaying, by the computer system, a set of overrides applied to the first data node, wherein the set of overrides is displayed within a third area of the graphical user interface.

3. The method of claim **2**, wherein the set of overrides displayed within the third area of the graphical user interface further comprises:

an indication of the second tile, the second value of the second set of data nodes, the indication of the first tile, and the first value of the first set of data nodes that is overridden by the second value.

4. The method of claim **3**, further comprising:

in response to the selection of an override in the third area of the graphical user interface, focusing the second area of the graphical user interface on a corresponding data node that includes the value for the override in the third area of the graphical user interface.

5. A computer system comprising:

a hardware processor; and

an integrated development environment in communication with the hardware processor, wherein the integrated development environment is configured:

to display a set of tiles, each tile corresponding to a set of data nodes that are composable structured data objects according to a domain-specific language, wherein the set of tiles are displayed within a first area of a graphical user interface; and

to display a structured data object composed from selected tiles within a second area of the graphical user interface, wherein displaying the structured data object includes:

to display, in the second area of the graphical user interface, a first tile within a context of the structured data object, wherein the first tile corresponds to a first set of data nodes;

to display, in the second area of the graphical user interface, a second tile within the context of the structured data object, wherein the second tile corresponds to a second set of data nodes;

to display, in the second area of the graphical user interface, a value override at the first tile when a first value of the first set of data nodes is overridden by a second value of the second set of data

nodes, wherein the value override at the first tile includes an indication of the second tile;

to display the first tile in association with a first sidebar having a first color;

to display properties indicated by the first set of data nodes in association with sidebars having the first color;

to append, by the second set of data nodes, additional properties to a first set of nodes;

to display the second tile in association with a property override, wherein the property override is a second sidebar having a second color; and

in response to a selection of an override toggle control, to remove the value override from the second area of the graphical user interface, wherein the selection of the override toggle control does not remove the property override from the second area of the graphical user interface.

6. The computer system of claim **5**, wherein the integrated development environment is further configured:

in response to a selection of a first data node in the second area of the graphical user interface, to display a set of overrides applied to the first data node, wherein the set of overrides is displayed within a third area of the graphical user interface.

7. The computer system of claim **6**, wherein the set of overrides displayed within the third area of the graphical user interface further comprises:

an indication of the second tile, the second value of the second set of data nodes, the indication of the first tile, and the first value of the first set of data nodes that is overridden by the second value.

8. The computer system of claim **7**, wherein, the integrated development environment is further configured:

in response to a selection of an override in the third area of the graphical user interface, to focus the second area of the graphical user interface on a corresponding data node that includes a selected override value.

9. A computer program product for composing a business rule, the computer program product comprising:

a non-transitory computer readable storage media;

program code, stored on the computer readable storage media, for displaying a set of tiles, each tile corresponding to a set of data nodes that are composable structured data objects according to a domain-specific language, wherein the set of tiles are displayed within a first area of a graphical user interface; and

program code, stored on the computer readable storage media, for displaying a structured data object composed from selected tiles within a second area of the graphical user interface, wherein displaying the structured data object includes:

displaying, in the second area of the graphical user interface, a first tile within a context of the structured data object, wherein the first tile corresponds to a first set of data nodes;

displaying, in the second area of the graphical user interface, a second tile within the context of the structured data object, wherein the second tile corresponds to a second set of data nodes;

displaying, in the second area of the graphical user interface, a value override at the first tile when a first value of the first set of data nodes is overridden by a second value of the second set of data nodes, wherein the value override at the first tile includes an indication of the second title;

displaying the first tile in association with a first sidebar having a first color;

displaying properties indicated by the first set of data nodes in association with sidebars having the first color

appending, by the second set of data nodes, additional properties to a first set of nodes;

displaying the second tile in association with a property override, wherein the property override is a second sidebar having a second color; and

removing the value override from the second area of the graphical user interface in response to a selection of an override toggle control, wherein the selection of the override toggle control does not remove the property override from the second area of the graphical user interface.

10. The computer program product of claim **9**, further comprising:

program code, stored on the computer readable storage media, for displaying a set of overrides applied to a first data node in response to a selection of the first data node in the second area of the graphical user interface, wherein the set of overrides is displayed within a third area of the graphical user interface.

11. The computer program product of claim **10**, wherein the set of overrides displayed within the third area of the graphical user interface further comprises:

an indication of the second tile, the second value of the second set of data nodes, an indication of the first tile, and the first value of the first set of data nodes that is overridden by the second value.

12. The computer program product of claim **11**, further comprising:

program code, stored on the computer readable storage media, for focusing the second area of the graphical user interface on a corresponding data node that includes a selected override value in response to a selection of an override in the third area of the graphical user interface.

* * * * *